

July 1, 1957

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AVIATION WEEK

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PUBLICATION

Passive Radar Uses
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First Pictures of
New Utility Jets

Goodrich Full Pressure Suit



AVIATION CALENDAR

July 23-24th National Sailing Contest, Harris Beach, Miami, N. Y.
 July 24th-Beverly Hills Women Transcontinental Air Race, from San Mateo County Airport, Calif., to North Platte, Nebraska Airport, Pa.
 July 12-15-Birth of Lockheed International Venture Corporation, the National Air Races (dead rind) and the Kings Cup Air Race, Coventry Civil Aerodrome, Birmingham, England.
 July 13-19th-1957 Japan Air Cruise, Hida Airfield, Ft. Las Vegas, Nev. WPA: G. Ralph Gifford, Air Cruise Chairman, Junior Chamber of Commerce, 121 S. Bond St., Philadelphia, Pa.
 July 25-Third Annual Japan Air Fair, sponsored by Ford (Japan) and the Junior Chamber of Commerce, Ford International Airport.
 July 31-Aug. 4th-British Annual National Convention, St. James Hall, and Airport, Pasadena, Sherman Park and Shoshone Hotel, Washington, D. C.
 Aug. 1-3-Second Annual Experiments and First Annual National Flight International Symposium, Society of Photographic Instrumentation Engineers, Ambassador Hotel, Los Angeles.
 Aug. 1-6-1958th Annual Aviation Meeting, Institute of Aeronautical Sciences, U. S. Grant Hotel, San Diego, Calif.
 Aug. 18-19-Midwest Airplane Race, Oakland, Calif.
 Aug. 20-22-Boeing-Stellingsma International Aviation Conference, Miami, N. Y.
 Aug. 20-21-Western Electronic Show & Convention, Cow Palace, San Francisco.
 Aug. 26-28-29th Dynamics Symposium, Transport Properties in Gases of High Temperatures and Pressures, Goddard Space Station, Northwestern University, Evanston, Ill.
 Aug. 31-Sept. 1-Midwest Airplane Race, Ft. Wayne, Ind.
 Sept. 1-11-Birth International Aeronautical Conference, Royal Aeronautical Society (Continued on page 4)



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AVIATION WEEK • JULY 1, 1957

Vol. 46, No. 26

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John W. Legation, president, right, and Robert L. Donovan, vice-president and secretary, Interstate Air motive, Inc., Lambert Field, St. Louis.

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CAA-approved repair service is a feature of Interstate's operation. I. G. Airline, Inc. manager, at right, and R. E. Rogers, technical A. & E. mechanic.



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TRANS-SONICS
INCORPORATED

Burlington, Massachusetts

AVIATION CALENDAR

- (Continued from page 4)
and London, England
Sept. 24-1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England
Sept. 24-25 General Assembly, International Union of Geodesy and Geophysics, in conjunction with International Geophysical Year, University of Toronto, Canada
Sept. 24-25 Annual General Meeting, International Air Transport Ass., Madrid, Spain
Sept. 24-25 Twelfth Annual International Astronautical Conference & Exhibit, Cleveland, Ohio
Sept. 25-26 Pacific Area National Meeting, American Society for Testing Materials, Sheraton-Palace Hotel, San Francisco, Calif.
Sept. 25-1957 Gander Ferry and Flying Display, Royal Aeronautical Society, Weybridge, Weybridge, Surrey, England
Sept. 26-27-45th Michigan Automobile Conference, partly sponsored by University of Michigan Transportation Institute, Western Michigan University, and The Auto Club of Michigan, Ann Arbor, Mich.
Oct. 1-4 National Aeronautics Meeting, Aircraft Engineering Science & Aircraft Engineering Display, Hotel Amsterdam, Los Angeles
Oct. 2-4 Tenth Annual Meeting and Forum, National Business Aircraft Ass., Commodore Hotel, Denver, Colo.
Oct. 7-9-1956 Annual National Electronics Conference, Chicago, Ill.
Oct. 7-10 Transatlantic Exposition, Leves Flight Progression Laboratory, Cleveland
Oct. 7-12-1956 Annual Congress, International Astronautical Federation, Geneva, Spain. For details enter IAF, 31 Lunell Rd., Geneva, Spain
Oct. 9-11 National Fall Conference, Society for Experimental Space Analysis, 22 Costa Hall, San Diego, Calif.
Oct. 10-12 Canadian Astronautical Institute, Institute of the Astronautical Sciences Meeting, Montreal, Canada
Oct. 12-13 Conference on new developments in the field of space, American Society of Mechanical Engineers, American Hotel, Allentown, Pa.
Oct. 14-15 Fourteenth Annual Display, Aircraft Electrical Engineering Society, Pacific Aircraft Association, Los Angeles, Calif.
Oct. 16-17 Thirtieth Annual Meeting, Association of the U. S. Army, Sherman Hotel, Washington, D. C.
Oct. 16-18 Annual East Coast Conference on Astronautical and Mechanical Electronics, Fifth Regiment Assembly, Baltimore, Md.
Oct. 18-19 National Industrial Packaging & Handling Symposium, Atlantic City Convention Hall, N. J.
Nov. 3-7-1956 Military Institute Guided Missile Reliability Symposium, Orlando in show with Space Academy element, Naval Air Missile Test Center, Pt. Mugu, Calif.
Nov. 18-19 International Air Transport Ass. Technical Conference, Miami, Fla.

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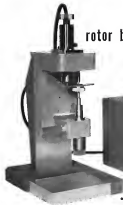
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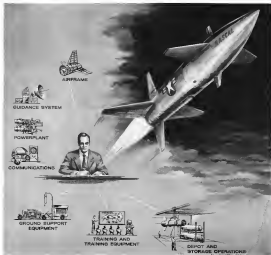
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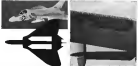
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EDITORIAL Where Do We Stand?

Events of the past few weeks in the White House, Pentagon and in Capitol Hill have created an enormous state of confusion and uncertainty as to the present status of our military manpower program. Although considerable confusion still remains, and it is certainly impossible to reconcile the divergent policies being passed by the White House and the Department of Defense, some of the dust has settled as a result of meetings before the Senate Appropriations Committee and in the Pentagon between USAF and aviation industry leaders.

Some clear trends, most of them reported as *Aviation Week* last month, have been outlined to military leaders in brief and understandable terms by top USAF leaders. And some of the financial legislation by which the military manpower program would have been acceptable (damaged) has been exposed and expanded from the Pentagon record, thanks to the courageous and candid actions of USAF Secretary James H. Douglas.

Most important is the fact that there is no change in the long range, overall planning for the procurement of airplanes, powerplants, avionics equipment, missiles and supporting equipment. This will continue to run at about a \$10 billion annual level with a steady breakdown of about \$7 billion for USAF, \$2.5 billion for Navy and close to \$1 billion for the Army.

However, there will be significant changes in the composition of the \$10 billion market now of which should come as no surprise to readers of *Aviation Week*. The trend towards a larger portion of the military hardware sales dollar going for avionics equipment started more than five years ago and is continuing along the rising curve of recent years. Missiles will naturally account for an increasingly larger portion of this market in the future. But even in other advanced areas now contemplated, missiles are not an ultimate absolute weapon nor is there any serious thought in the Pentagon that they will ever completely replace manned vehicles in the military manpower arsenal.

For several years, going back to the days when Roger Lewis was assistant secretary of the Air Force for military, top USAF leaders have been warning the industry that there were becoming increasingly serious to their being and were placing heavy emphasis on a first past performance in avionics production and technically sound development. They also warned that as weapons systems became more complex and expensive the per power dollar would be concentrated in fewer but larger weapons systems, and the competition for these larger plants would get increasingly stiffer.

In the recent Pentagon meeting (AW June 24, p. 24), USAF leaders have again emphasized this trend and given industry management some clear guidelines by which the Pentagon will judge efficient contractor operations in the future. Incidentally, this is the first such USAF industry meeting of this type since Defense Secretary Charles E. Wilson and his then Undersecretary Roger Kinn examined aviation leaders in the Pentagon for a week beginning in the spring of 1953. We think these meetings are an excellent idea and should be held periodically to promote a closer liaison between the military customer and the industry that is serving them.

Industry management can find little to quarrel with in the USAF request that it reduce overhead, streamline its manning approach that specialized engineers like command and return to a more qualitative evaluation of engineering output, streamline productive methods to get lower unit costs, and keep technical development active in the fields that will dominate the future.

During the heyday of the Korean war experience and its aftermath from 1950-55, management of security became loose and overhead grew disproportionate. Some companies are the beneficiaries on the wall several years ago and have steadily moved to high their manning, improve production and put the emphasis on technical quality rather than sheer quantity. Others will have to follow suit or drastically tightening their man agreement on their prospects for survival, in the future available for weapon system contracts will indeed be slim.

Similarly, the anticipation and increasing of new technical trends to the forefront of individual firms continues, as it always has been in this industry, to be an indispensable element of economic survival. Engine manufacturers who have concentrated on the helicopter to the exclusion of rockets, jets, chemically fueled and nuclear engines will find future going tough. Avionics manufacturers who have developed no work on avionics capacity or white technical scope and depth is not sufficient to handle game weapon systems will have to shift their patch to subsystem or component work or find their fortunes fading. Companies who find their military market falling will have to test their ingenuity to get a larger share of the rapidly expanding commercial markets for executive transports, civil helicopters and airline transports.

Thus it is clear, as it should have been to anybody who read the technical underwriting on the wall or listened to the speeches of Roger Lewis, Lt. Gen. C. S. "Bill" Lewis, deputy USAF chief of staff for material, and Maj. Gen. David Bailey, chief of procurement for Air Materiel Command, that the aviation industry and its related technologies are in for a period of shifting locations for individual management which the new era for aviation will be greater and the penalty for failure will be a sharp economic hit.

There are still some serious and, we hope along with Secretary Douglas, only temporary fiscal problems in the funding of the manpower program over the next 12 to 24 months. The ill-advised attempt to drastically cut partial financing of long range equipment programs has been abandoned since its full implications were made clear by Secretary Douglas. However, the problem of holding fiscal expenditures within the statutory debt limit still has grave implications for the Pentagon. Even the program proposed by President Eisenhower for Fiscal 1958 does not provide for rising expenditures of a sound manpower program and will reduce the rate of progress toward the manpower strength goals consistently generated by the American people by the President and his defense aides. Even Defense Secretary Wilson is now alarmed at the prospect of being up to manpower cuts at the very time when our international bargaining position is becoming most critical. So are we. —Robert Helt



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WHO'S WHERE

In the Front Office

Alan Eaton, president, General Transistor Corp., newly established subsidiary of General Transistor Corp., Inc., N. Y. — **Alan Walter Rosen**, vice president and general manager.

I. W. Kerner, president, The R. F. Goodrich Co., Akron, Ohio. Mr. Kerner was formerly William R. Kerner, vice president.

G. W. Hall, chairman, The Farny Associates Co., Ltd., Middlesex, England. Mr. Hall continues as managing director of the British company.

Paul M. Martin, executive vice president, Marlow Chemical Division, Borg-Warner Corp., Chicago, Ill.

Robert S. Davidson, vice president, Wala Laboratories, El Segundo, Calif.

James W. Swales, vice president, Vetroc, Inc., El Segundo, Calif.

John E. Shibley, vice president, Berman Corp., Burbank, Calif.

Edgar Schaefer, vice president, Pacific Northern Electric, Inc.

C. E. McCullough, vice president national accounts (New York), Titan World Air Lines, Inc. — **J. C. Berger**, national M. McCullough is vice president national accounts (Chicago).

Gerold Rosenberg, a vice president, General Electric Corp., Skaneateles, N. Y.

John A. Dandale, vice president general administration, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Michael Lethbridge, executive minister to the president, Eastern Air Lines, Inc. — **Joseph E. Kline**, executive in the president, General Electric Corp., Valley Stream, N. Y.

Reg. Gen. Francis F. Uhlman has been appointed Deputy Chief of Staff, Communications and Electronics, Continental Air Defense Command, Colorado Springs, Colo.

Robert L. Johnson, Newport news manager (President, Germany), Alcoa Co., Cal and Helton Corp., Indianapolis, Ind.

Honors and Elections

Cal Borel (Belmont, aviation pioneer) has been named outstanding aviator of the year by the National Business Aviation Association. Borel was the first to receive the newly established award.

Dr. Carl Frank K. Ernst, Jr., first pilot in the Bell X-2, has received the 1957 Otis C. Cline Award from The Institute of the Aeronautical Sciences. The institute studies current problems in the development of rocket-powered flight test techniques.

Dr. Irving Pichel, mechanical sciences research of the NASA Lewis Flight Propulsion Laboratory, has received The National Advisory Committee for Aeronautics high award, the Distinguished Service Medal, for his scientific research on issues of jet and rocket engine in specific engines.

These scientific contributions enhance the safety of air transportation.

Andrew B. Shaw, president of Pan American Airways, Inc., has been awarded an honorary Doctor of Laws degree from Southern University.

INDUSTRY OBSERVER

► Reaction Motors powerplant for North American Aviation's high-off-boost N-15 research vehicle will have a thrust of approximately 68,000 lb., a burning time of between one and three minutes.

► General Electric engineers in charge of the Atlas project estimate that about 95% of the engineering data interpreted from the first test firing of the experimental "bell-like" missile at Cape Canaveral, Fla. (AW June 17, p. 27) was obtained before the missile was destroyed in the air by the range safety officer because of control problems.

► Lockheed will complete production of the 44 Model 1649 Starliner transports now on order by the end of the year end, unless further orders develop. The corporation will take a substantial loss on the project.

► Douglas engineers are betting that North American Aviation Inc. will get the USAF order for the two-engine crew subsonic business transport with a Suburban (AW June 24, p. 31) showing a top speed of 540 mph and a cruise speed of Mach .70 at 25,000 ft. Suburban will be powered by General Electric J85 turbojets located in wing roots.

► Syntex Electric will announce development this week of a new type flat tube display with possible applications in radar, television and computers.

► Navy is becoming increasingly strict in its requirements for manufacturers to meet performance and weight estimates of new aircraft. Profits were cut on North American's F-102 jet because the aircraft's stall speed was found to be six knots higher than predicted and it was 10 lb. overweight.

► First Republic F-900 high speed interceptor powered by a turbo-ramjet engine is scheduled to roll out in February if it isn't caught first by USAF's economy pinch.

► Hiller Helicopters has developed a propulsion unit for the Army composed of a set of up to eight subsonic propellers mounted in vertical plane for attachment to preselected rotor systems. That would lift loads anywhere from the ground, by it at speeds of up to 30 mph, then lower it into place at its new location. Powerplants are French Sauron turbojets. Number of propellers can be varied in the propulsion unit according to requirements.

► Republic Aviation is conducting a USAF design study to develop an all-weather hydraulic system that can operate on an environment of 1,000°F.

► Army has just completed field tests of a modified Buach L-21 fitted with engine 2,400 hp. In place of the existing engine. Modified version also has custom type boundary layer control system and other jet reducing features designed by Dr. August Raper of Minnesota State College. In a typical compression run, the Buach version flew at 160 ft at 61% power with 50 statute feet, while the standard Army version flew at 160 ft at 85% power with 100 statute feet. Total research cost of the modified version was \$21,000.

► Bell Helicopter Corp. has raised the gross weight of its Model 47 helicopter from 2,400 lb. to 2,500 lb. by installing a new engine. The new engine is the engine control system. CAA approval of the new gross weight includes certification for operation of the helicopter's hovering VO-415 engine at 240 hp., a 24 hp. gain. Modification kit will be available for present 47 operators.

► Recent research in meteoric burst communications (AW June 17, p. 90) using high power radar has avoided the confusion of meters too small to be seen previously and between apparent correlation between precipitation and the presence of small satellite showers. One theory on the meteoric bursts that trigger rain and snow storms is that the tiny meteoric particles provide the nuclei for releasing precipitation.

► North Atlantic Treaty Organization plans a new military outfit at Kalam, Turkey. Estimated cost: \$1.9 million.

New Airborne capacitors and filters are smaller, lighter ...

aid miniaturization of electronic devices

MINIATURIZED CAPACITORS

Thin-film Mylar dielectric and a special conductor. Airborne miniaturized capacitors offer miniaturized ratings up to 12 times higher than those of ordinary capacitors of comparable size and weight. Vacuum impregnated and hermetically sealed in drawn steel cans or epoxy

sheets, they have excellent resistance to vibration, fatigue, salt spray and humidity. Airborne standard miniaturized capacitors are rated 200 \times d-c and have an operating temperature range of -55°F to $+350^{\circ}\text{F}$ with only 12% equivalent change. At 3000 V they handled 11500-volt surges for 250 hrs. through a resistance of 1 ohm per volt. Where standard designs are not suitable,

Airborne can produce special capacitors to meet your requirements. These custom miniaturized capacitors offer the advantages of reduced size and weight without sacrificing capacitor or dielectric strength. Typical is one of our new surface capacitors which is 75% lighter yet has twice the capacity and does retain the dielectric strength of the old-style capacitor it replaced.

STANDARD CAPACITORS



TYPICAL SPECIAL CAPACITORS



Airborne Standard Miniaturized Capacitors			
Style	Size	Capacity	Weight
A	1/2" x 1/2" x 1/2"	100 pF	0.0015
B	1/2" x 1/2" x 1/2"	100 pF	0.0015
C	1/2" x 1/2" x 1/2"	100 pF	0.0015
D	1/2" x 1/2" x 1/2"	100 pF	0.0015
E	1/2" x 1/2" x 1/2"	100 pF	0.0015
F	1/2" x 1/2" x 1/2"	100 pF	0.0015
G	1/2" x 1/2" x 1/2"	100 pF	0.0015
H	1/2" x 1/2" x 1/2"	100 pF	0.0015
I	1/2" x 1/2" x 1/2"	100 pF	0.0015
J	1/2" x 1/2" x 1/2"	100 pF	0.0015
K	1/2" x 1/2" x 1/2"	100 pF	0.0015
L	1/2" x 1/2" x 1/2"	100 pF	0.0015
M	1/2" x 1/2" x 1/2"	100 pF	0.0015
N	1/2" x 1/2" x 1/2"	100 pF	0.0015
O	1/2" x 1/2" x 1/2"	100 pF	0.0015
P	1/2" x 1/2" x 1/2"	100 pF	0.0015
Q	1/2" x 1/2" x 1/2"	100 pF	0.0015
R	1/2" x 1/2" x 1/2"	100 pF	0.0015
S	1/2" x 1/2" x 1/2"	100 pF	0.0015
T	1/2" x 1/2" x 1/2"	100 pF	0.0015
U	1/2" x 1/2" x 1/2"	100 pF	0.0015
V	1/2" x 1/2" x 1/2"	100 pF	0.0015
W	1/2" x 1/2" x 1/2"	100 pF	0.0015
X	1/2" x 1/2" x 1/2"	100 pF	0.0015
Y	1/2" x 1/2" x 1/2"	100 pF	0.0015
Z	1/2" x 1/2" x 1/2"	100 pF	0.0015

MINIATURIZED R.F. FILTERS

Airborne miniaturized R.F. filters are entire Mylar dielectric and a special reflecting material so reflect size and weight without compromising performance. Cores are sealed in airtight stainless steel cans with their own lead. Vacuum impregnated with polyimide resin, hermetically sealed in steel cans with glass leads. Airborne miniaturized R.F. filters are available from -75°F to $+350^{\circ}\text{F}$. They meet JAN-C-23, MIL-C-18181, and MIL-M-8809 and are available to your specifications. Typical standard components and circuitry are shown in right where multi-performers also as the models in which these filters were matched. Mounting brackets are furnished to meet your requirements.

TYPICAL R.F. FILTERS



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New Overtime Directive

Recent statute directing ending overtime pay is actually contained (AWM News & p. 29) have been drafted and amplified in a new Department of Defense Instruction (4005-48) which is also intended to give authority to defense contractors. Defense left Army had gone too far in allowing overtime, that Air Force hadn't gone quite far enough. New statute is closer to Navy's version.

Service still has ample room to exempt projects from overtime restrictions, and this will be done to a large degree with most military missile contracts. New order actually allows the contractors somewhat, leaving more allowance for emergency, etc. But the subject is already stated: "To effect an immediate, continuing and sharp curbing on the use of overtime in the particular area of all lands and types of Department of Defense procurement contracts."

Power to authorize overtime, up to 25% of a project's total man hours, remains with plant representatives. As long as that limit is approved by government agencies. Disputes, where action by one service might preclude another of another service in the same plant, can be handled all the way to Assistant Secretary of Defense for Supply and Logistics for final decision.

Defense officials themselves are worried about setting current spending rate but also say lessons had been learned in mismanagement of overtime and it is good business to cut it back.

Word "mismanagement" means halfhearted on overtime will be at least through Fiscal 1958, but Defense agencies and contractors will be granted whatever the total cost of spending on overtime here appears to be cutting more than proving overtime.

Instruction also directs that use of overtime pay as part of an employee's salary is "subject to the provisions of this instruction."

House Senate conferees last week approved a \$406 million Fiscal 1958 budget for the National Advisory Committee for Aeronautics. The figure is about \$73 million more than the fiscal 1957 budget. However, NACA had requested \$135 million.

The House showed \$185 million but House conferees last week accepted the \$406 million voted by the Senate and also went along with a Senate provision curtailing NACA's authority to contract with non-federal and other private institutions for research and development work but it did place a limitation of \$500,000 on this type of contracting. Earlier, the House had banned outside contracts by NACA.

Acceptance of the \$406 million by House and Senate is expected to be achieved. The total is divided:

- Operations, \$71 million as compared with \$62.6 million for Fiscal 1957
- Construction and equipment, \$55 million as compared with \$14 million for Fiscal 1957.

Air Defense Problem

Watch for Rep. Gus Wadsworth M. Texas to move into the Pentagon as assistant chief of staff of the Air Force for air defense. That would be similar to the special job created for a month or two earlier several years ago for similar reasons relating to improving the air defense picture. Bates is now head of the Weapons Section Main Agency Office of Air Research and Development Command at Wright Air Development Center. During a

recent presentation to the Institute of the Aeronautical Sciences at Los Angeles, Calif., Bates noted that the air defense problem might require the creation of a special civilian civilian manager similar to the Range-Woodbridge Corp. relation to the USAF ballistic missile program.

New Investigation

House Armed Services investigating Subcommittee headed by Rep. Edward R. Roybal (D-Cal.) plans a "large-scale" investigation of missile and other defense contractors. "Particularly, we want to find out how much profit these contractors are making on subcontracts," Roybal says. "The investigation will be conducted on a very broad basis. We will be looking for any and every instance of overpricing or mismanagement in the procurement process and making of it, particularly in the area of subcontracts on July 1 (AWM News & p. 27).

Small Business

Watch for a change in the definition of "small business." This means that some firms which now enjoy the advantages of government regulations aimed toward assisting "small business" will be removed from the category and others will be added. Congress is strongly opposed to the arbitrary criterion of "500 or less employees" which has been used until now. The House and Senate Small Business Committees will either the law such as net worth, dollar volume, position in its field, etc., considered.

Farewell to OSI

Office of Strategic Information died with the end of Fiscal 1957; in the period Congress Department decided not to ask the Senate to authorize funds needed for its annual which had been cut out to the House. House Government Information Subcommittee urged abolition of OSI after hearings last year. Chairman John E. Moss (D-Calif.) and OSI had been unable to push its existence either for restricting unclassified information from within the government or controlling unclassified information from outside the government and said the office "ceased to operate in an state of complete confusion." (AWM News & p. 27) a highly resolute attitude of check-and-balance still persists.

New Arms for Korea

USAF wants to Korea as first being equipped with aircraft to meet equally match the MIG-17 fighters that have been moving into North Korea since the signing of the armistice almost four years ago.

Officially both the Pentagon and Air Force officers on the scene has declared to say what they want, it will replace the North American F-86s, a long-term from the Korean War. But let, however, are North American F-100s recently sent to Japan.

Modernization plan was preceded by United Nations Council recommendation that it was fulfilling the arms process in the armistice designed to get rid of the arms clause of new weapons into Korea. Commanders, who also agreed to the process, began moving new arms and aircraft into North Korea from China within days after the final agreement was signed in the summer of 1953.

—Washington staff

USAF Gives Industry Guides to Survival

Top Air Force officials tell industry how to live under administration-imposed spending ceilings.

By Evert Clark

Washington—Industry has been given guidelines for survival as Air Force programs to stay within administration-imposed spending ceilings in spite of rapidly rising costs and the consequent transfers to more missiles and lower aircraft.

Details of a recent Pentagon briefing for top industry executives (AW June 24, p. 35) reveal that USAF has told management to:

- **Cost overruns.** Figures suggested a 12% cut, the amount by which USAF is cutting its headquarters overhead in fiscal 1975. Included are personnel, leased space, facilities, etc. Aircraft prime contractors were told they face the alternatives of reducing plant production facilities or eliminating all changes to the government contract.
- **Cost engineering cuts.** This already has resulted in delays aimed at severely curtailing customer (see p. 29). Another target is duplication of various engineering capabilities at branch and division plants. Contractors were warned against "using the method of quality engineering."
- **Cost and price.** Even though production volume is reduced, patterns have been that unit cost is highest when volume is lowest. Industry was told, however, that lower weapon returns will lower volume of use will be generated in the next five years, and that unit cost must rise down in spite of lower sales.

Assistant Secretary for Material De-

lv C. Sharp called for contractors to cut the war from "creative composition" to labor costs.

Li Gan C. S. Irvine, Deputy Chief of Staff for Material, and members of the "very real problem" will require "changes in thinking not only here in the Pentagon but in the management of every plant in the country, and right down to the field doing the work."

Besides obviously being placed largely on individual management even though broad guidelines have been laid down, further briefings will be held, and direction and personnel matters will be issued both by Defense Department and Air Force.

Briefing Highlights

- **Other highlights of the briefing.**
 - **Fixed wing.** Although it has helped create the current situation in which spending is running ahead of estimates, has been virtually eliminated as a part of the current problem. Cooperation between Defense Secretary Charles E. Wilson and his counterparts, Wilfred McNair, on one hand and Air Force on the other will result in less and less partial funding as they pass on, but contractors will be gradual enough not to jeopardize USAF's program.
 - **Wing strength.** Secretary James H. Douglas admitted that USAF "heavily dropped this year's wing count" at what has been almost steady as in the 1970-71 fiscal year, as well as set by Aviation Week last Jan. 21 (p. 26). "We have changed the composition of that program a little bit so that we actually have 157 wings, but there is

the reduction of five that I refer to," Douglas said. Nine more wings have been cut from the fiscal 1975 budget, Douglas said, "so that really in a period of about a year and a half we will have programmed out roughly 10% of our wing strength."

- **Structures and modification of contracts.** Sharp made it clear that there is largely no problem as far as contractors will require "some level of drastic action, Sharp said. "We may take the form of the elimination of some programs. We hope not, we do not know, it may take the form of something not some of our programs."

- **All of us are going to have to re-define an unadmittable understanding."**
 - **From which have not moved into static and electronic fields will be hardest hit (see box below). Turbojet engine manufacturers face sharp cuts—45% of current procurement—over the next few years, with sufficient rest in line.**

"The regime of the turbojet engine, development and production-wise, appears to be looking in the not too distant future," Maj. Gen. David H. Bowers, director of procurement and production for Air Materiel Command said. "Production facility data for this industry is in severe, or even worse, than that... for the aircraft production shell. The proposed production quantities will not support the present complex of jet production. Therefore, a shrinkage in engine plant capacity for the jet products is indicated in the years ahead."

Limited Means Cheaters

- **"Significant changes" in company's production.** Being large numbers of aircraft engines and jet engines quantities will almost inevitably result in fewer prime weapon returns contracts. Gen. Bowers and Money will be turning to the industry through a week some initial reaction of officials. Neither the R&D nor the procurement budget can continue to support the loss of new system contracts on the scale that now exists.

Weapons system contracts will have more and more impact on it, especially in electronics.

Consequently, Bowers said, include continuation of USAF's policy that as cost overruns "the program is reduced amount" will be "concentrated as available systems exist even though some electronic companies have, with good justification, argued that this should be done in complex missile systems. This program will be "concentrated as available over the next few years. Penalties, however, in the fact that some spending is running above those levels, and the administration seems that it is not.

"If we are to control the present situa-



F-104 Inlet Uses Two Boundary Layer Bleeds

First bleed of the Lockheed F-104 inlet shows two boundary layer bleeds. First bleed is large gap between the inlet and the side of the aircraft which allows the boundary layer to pass the duct without spilling. Second bleed is visible inside the duct just behind the spike. The third bleed prevents separation in the corner of the spike and then turns to enter the engine. Third bleed is visible on the leading edge of the spike near the base where the shock wave is created by the spike.

tion within contractors to live with planning and integrating subventions, we need more companies who have a more plan action than capabilities, both design and production-wise" (AW June 24, p. 39).

"There is a clear requirement for these companies to be qualified to expand their horizons and more, especially in the area of the aircraft industry, to be able to meet the requirements of the program."

Deliver Availability

• **Deliver availability.** Financing is going ahead on the theme that the critical levels of approximately \$7 billion for procurement and production, \$750 million for research and development and \$10 billion for operations of USAF will be available over the next few years. Penalties, however, in the fact that some spending is running above those levels, and the administration seems that it is not.

Although spending estimates for fiscal 1975 and 1976 were far off from what actual spending has turned out to be, Douglas and procedures need to make the estimate "more realistic and fairly accurate" in fiscal 1975, 1976 and 1977.

But "rapid spectacular growth of the helicopter market program during fiscal 1977" shortened the time, obligating each in the year and comparing programs, rising costs, and other factors not spending out of the.

"The program in the helicopter market program during the year (fiscal 1977), in doing this, the first one month of the fiscal year, substantially doubled its against the estimate for that program when the budget for 1977 was formulated in the Air Force," Douglas said.

"Also the answer is that the program has been financed but contributed to the situation in that we have not been financing the purchase of end items two years in the future. We have really been paying for effort as we went

along, and making available funds to meet the requirements for the next year or six months."

"Although it was realized that the program would spend more rapidly than a current program, it was never estimated that it would spend at the rate of something like 60% to 70% in the first year of the program."

Hold Unit Cost Down

• **Unit price.** Sharp said "we ought to look carefully" at the "careless" thinking in Air Force and the industry that a reduction in the rate of production is accompanied by a reduction in the unit price. "We must find ways to reduce the cost and the other expenses to keep the cost of the product very close to the cost of the same as they were when they were produced in higher quantity. This will take all of the ingenuity, I am sure which you can do."

• **Engineering.** "It is fairly new to take a good look at all of our engineer-

Where USAF Dollars Will Go

Washington—Breakdown of planned Air Force expenditures over the next several years, reflecting the rapid shift in emphasis from manned aircraft to missiles, was given to industry leaders at a USAF briefing by Maj. Gen. David H. Bowers, director of procurement and production for Air Materiel Command.

Figures are based on an expected constant dollar availability of \$7 billion and do not consider any obligation to expenditures ceilings which might be imposed in the future, Bowers said. They also exclude research and development and operations and maintenance procurement items. Area of comparison is fiscal 1974.

- **Aviation—Drop from \$4 billion to \$2 billion in "increasing difficulty" over the 52 months.**
- **Missiles—Increase from \$500 million to around \$2.5 billion from a total of \$2.3 billion, which more than offsets the loss in aviation. Bowers explained that some electronic spending is included in this missile figure but more is reflected in the electronics area itself.**
- **Engineers—Drop from \$2.5 billion to less than one billion, or a reduction of nearly 70%. Turbojet engines will drop 40%, but engine and rocket engine sections will partly offset this, Bowers said.**
- **Electronics—Jump from \$750 million to \$1.5 billion, about doubling and reflecting "the increased role of electronics in the complex weapons we are building."**

Norstad Details 'Accidental' War Chances

By Chuck Witz

Paris—Gen. Louis Norstad, supreme allied commander for Europe, is not optimistic that any clash at NATO borders with the Soviets could be contained to a local war on his command. His reasoning is simple: The Gen. can't tell.

"Could the Russians start what they believe will be a local war and accept defeat?"

"Could they start a war using small atomic weapons and accept the temptation to add bigger and more potent ones to the fighting program?"

In both cases, the obvious reply is negative. Gen. Norstad's own words are clear: that if war starts it will be a general war, but he does not believe that Russia is in a position to defeat a steady state of a conflict. The difference is USAF's Strategic Air Command.

Both Gen. Norstad and spokesmen for the U.S. Seventh Army in Germany indicate the sensitive border along East Germany, Czechoslovakia, Greece and Turkey has a low probability of an "accidental general war." On top of this are the nuclear facilities, such as a nuclear reactor, which are a threat to the war in Hungary. The other NATO nations' opposition will go on a 24-hr. alert.

In Gen. Norstad's opinion any effort to place a line on the size of atomic weapons to be used in case of war would be only passive destruction of the NATO "shield fence" in Western Europe. He points out that the Russians and NATO will start any war that breaks out. This gives them the initial advantage which then goes to the victor. To rule out a possibility of tactical situations as they develop, the Soviets would be under pressure to throw more and more potent weapons at the West. Gen. Norstad says this is a serious advantage with each generation. It would be acceptable for the NATO powers to keep ahead and not be guilty of violating any agreement they had made to limit the size of weapons.

SHAPE's chief is confident that support of NATO is indispensable in spite of the fact that changes have been made in military support by some member nations. He says NATO's "insurance" will be cut with the proposed loss of 13,500 British soldiers, largely because they are excellent troops.

On the other hand, this will be offset in some degree, starting within a week, as the first three divisions of the new German army are added to NATO's camp. Eventually, there will be 12 German divisions in the total of 30 under Gen. Norstad's command.

So far, an answer is reserved, the NATO nuclear force in Europe is five or ten times larger than it was in 1951. At that time, about President Eisenhower was told at SHAPE headquarters that he had only 12 NATO airfields. This was not modern and was not properly equipped.

Today, according to Gen. Norstad, there are more than 150 modern NATO airfields in use. Of more will be added to the network by the end of 1953. In addition, there is an enormous large number of airports not under NATO control but available to NATO air forces in event of war.

There is an active program under way to protect these fields and other points against the NAU aircraft. The airports themselves have been moved from 32 inches to 54 inches wide. In addition, a half mile will be covered by 8-100 inch radius of air, had population.

Responsibility for Europe's only nuclear mission was laid on Gen. Norstad's desk with a few days. At that time, each border nation was to provide its own air force. There was no coordination of equipment in type and capability, large war reports were not controlled and long distances of the border were covered by radio beacons which could be a day and five days a week.

NATO now has on order a new order system comparable to the North Atlantic Treaty Organization. It will be the type of thinking aircraft 100 miles behind the front line. Scheduled for completion in 1955, it will operate 24 hours a day and provide an efficient radar system. From this, the NATO will be able to provide a warning for NATO's command located at North Atlantic, Alaska and Japan.

Despite the fact that there is a USAF ally, Gen. Norstad, part of the plan upon the acquisition of NATO's ground forces in Europe. There are some doubts at SHAPE headquarters with the opinion that he is more con-

fident about this than his predecessor, Gen. Alfred M. Gruenther. Army officers.

Gen. Norstad himself says that there are "no nuclear weapons" in the air force's hands and he is working hard to correct them with such things as the new high sounding low and addition of the German Air Force with more than 1,000 jet combat aircraft.

On his ground forces he says, "They can not get what they should be." And the matter still remains has been in the dispute between American weapons and those of our allies, especially in the field of nuclear delivery vehicles.

He says the European allies differ from the American most conspicuously as the only he uses and indicates that it is up to the United States to correct this situation.

The line between NATO and the Soviet bloc is about 4,000 miles long. Gen. Norstad believes a war could start anywhere on this line should the potential make an error in judgment at that time, some nuclear or conventional action.

Because of this possibility he says "we cannot count on it as a point along our entire frontier the defense strength which the Soviet threat is."

"The reason might keep up a great fear for creating the frontier. We would then face not only an unexpected first but also a dilemma. If we did not take immediate action, we would have to expect the consequences of the attack if we did take it, we would start a war."

From this, it follows that the air and ground defense forces deployed in Europe are an integral part of NATO's defense posture.

According to Gen. Norstad, the most probable start NATO has in the defense situation to use the lower of the world arms. The will be not it, he says, not be produced and strategical like atomic bombs.

Sixth Fleet Is Ready, Confident

Palos, Michigan—Despite a major supply of fuel-line aircraft, the U.S. Sixth Fleet is confident that it will make a substantial contribution in the event of war.

Vice Adm. Charles R. Brown, Sixth Fleet commander, says the Sixth Fleet is ready to go at any time. He says it will, if there is, Brown says, the Soviet fleet will open the way for the Strategic Air Command. He adds that SAC would be free to hit the Russians

hard if they dared those at any time at the Sixth Fleet's hands.

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hard if they dared those at any time at the Sixth Fleet's hands.

in Tokyo, Genoa, Italy and Western Europe.

There is no evidence that he will receive such and from air forces except those of USAF operating out of Germany and Northern Italy.

The Sixth Fleet today includes the carrier USS *Enterprise* and USS *Essex* carrying a total of 115 combat planes, three quarters of them for offensive strikes. The fleet's prime mission, Brown says, is to support land battles in Southern France.

The fleet arrived for this mission in the Douglas A3D last March Jan. 12. Another 72 are due soon when the *Essex* and *Essex* replace the present carrier.

The fleet at present has no ground support or ground force units on board, but the T-12s equipped carrier *Essex* is expected soon and the *Essex* will carry some 1,000 troops. The fleet's prime mission, Brown says, is to support land battles in Southern France.

Other aircraft in the fleet include the Douglas A3D, *Essex* and *Essex* and other planes used for early warning, reconnaissance, and other missions.

On top of this, the Sixth fleet has the aid of a large, light aircraft carrier force composed of one support carrier and six destroyers. Most of the group, which serves with the fleet on a rotation basis, is scheduled for September.

Brown says he has an air force mission and no duty at all, plus one to the *Essex* class carrier with their necessary support.

Such a move would double the size of the Sixth Fleet, which now has approximately 60 ships, 25,000 men.

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hard if they dared those at any time at the Sixth Fleet's hands.

A3D, A4D, F-101 Modified



Next generation carrier in front Douglas Phantom II, the A3D, is light plane carrier designed to improve coastal reconnaissance. Another model is good on North Atlantic F-101. Other changes: increased structural strength in fuselage and wings to take one of new power plants which has dual turbine engines, multiple exhaust system, single point engine intake system for ground A3D. Its completed flight hours of inspection survey prior to production at NATC. Phantom II and flight hours are expected in July. Several hundred are on order.



Changes in Douglas A3D are possible. There is more structural strength made in order to carry more. Higher thrust Pratt & Whitney J57 P-10 and 10,000 lb. is a first in place of 10,000 lb. 375 lb. Reducing length has will carry more types and amount of aircraft of more and more fuel capacity in ground.



Operational data on its J79 engine is being collected by General Electric with the McDonnell F-101. Douglas A3D, Lockheed F-101 also are not (J57) May 10, 1953. Wright report in 1951 with F7B included model of J79 is approximately 1,500 lb. All these aircraft were photographed in open house at Edwards AFB, Calif.



British P.1B Carries Inlet Spike

First English Electric P.1B reveals some of the changes from prototype including spike in inlet for increased engine inlet efficiency at supersonic speeds. Center body probably does double duty carrying radio equipment. Inlet of P.1B is slender rather than oval as in predecessor. Dual spine, which contains added crew bailout seats, is probably a nod to supersonic change. Speed brakes have been relocated to top of fuselage near leading edge of fin. Powerplants are two Rolls-Royce Avon, probably RA 146 and at 14,350 lb. thrust without afterburners.

Easing of 'Need-to-Know' Rule Proposed

Washington—Sharp modification of the "need-to-know" requirement for access to classified information is under consideration. The new of technical information access requirements and engineers is being urged by the Commission on Government Security.

The nine-member group—composed of three members appointed by the President, three by the President of the Senate and three by the Speaker of the House—recently completed a year and a half study of the federal security and security programs (AW June 24 p. 38) to its report, it declares:

"The application of the 'need-to-know' policy should occur only on those occasions when there is sound reason to believe that the national security will be adversely affected."

Gordon Testimony

The committee pointed to the testimony of Travis Galtman, former assistant secretary of the Air Force in research and development, "that access to, engineers and physicists 'need-to-know' all the facts they can get their hands on, because if it were difficult to ascertain which of them may develop a much needed idea. Applying 'need-to-know' criteria to a scientist's progress results in the crippling of progress. It is often impossible to define what a

scientist needs to know in order to accomplish his job."

It added, however, that controls under the individual security program will always be difficult because of inherent ambiguity of the "need-to-know"—and because entrance considerations tend to become stacked, such as the conflict between the general desire to find out what the other companies are doing and the natural reticence of those companies to disclose more of their processes and techniques than is necessary.

Other Recommendations

Other recommendations to achieve that aim, which the commission also should contribute substantially to an unimpeded balance between the

need for protection of the national security and the need for free exchange of ideas and information," were:

- Establishment of an Office of Security under the Secretary of Defense. "The security purposes of the three national services would be consolidated 'into a single, integrated program, derived, controlled, supervised and reported' by this office instead of three sets of regulations, thus would be one. Military security personnel, including its quarters, would work under and be responsible to the office rather than to three individual services."

- Company-wide compliance by any one government agency. This would expand the present policy within the Department of Defense under which a single service is assigned engineering over a single facility. It would not only extend the requirement to a company, wide basis but, in cases where military contractors also had nonmilitary jobs—for example, with Atomic Energy Commission—the company would be assigned to only one agency to do protection.

- Security changes would be made only after consultation with representatives of the industry concerned. The commission ruled out bilateral consent as a "requirement" because this "would accurately account the approval of

a New 400 CYCLE MOTOR

with integral gear box
for use in missiles and
jet aircraft



**SPECIFICATIONS OF EMCO
TYPE 0-800 MOTOR**

Model: 0-800, 400 cycle, 3 phase
Load: 2.5 hp continuous output
S.P.M.: 30,000 rpm, reduced at gear box
Power Factor: 87%
Overall Dimensions: 9 1/2" dia. x 10 1/2" high
Weight: 11.25 pounds
Note: Type 0-800 may be made up and
also used with other alternatives.

EMCO Type 0-800 is a compact, light weight 400 cycle, 3 phase motor with an integral gear box that operates at 3000 rpm. It was designed by EMCO especially for use in supersonic aircraft and missiles and meets MIL-M-7500-1000 specifications. Weighing only 11.25 pounds, it has a continuous output of 2.5 HP at 31.40 HP at the gear box. The power factor is 87% while the overall efficiency of the unit is 78%. Mounting flange is made in type, and 24-000.

A feature in the design of EMCO Type 0-800 is that the gear box acts as the motor support which places the line of gravity of the motor pump assembly. This enables the unit to withstand the extreme shocks and vibrations encountered in supersonic aircraft and missiles. With minor alterations, the motor can be made splash and A-frame.

Type 0-800 is another example of the fine craftsmanship found in all EMCO products. EMCO's entire effort is directed to the design and production of linear and rotary actuators and special motors of high torque light weight coils. Many of our jet aircraft and missiles being developed or delivered carry EMCO products. EMCO products are also used for industrial applications where precise control tolerances are required.

**Electrical Engineering
and Manufacturing Corp.**

4612 West Jefferson Boulevard
Los Angeles 18, California
Telephone: NOblesse 3-0331

**Designers and producers of motors,
linear and rotary actuators... exclusively**



At last a **FLEXIBLE Metal Hose** which can replace rubber tubing

Development of a flexible stainless steel hose with a smooth, turbulence-free interior now makes it possible to specify flexible metal hose in places where rubber or synthetic tubing formerly had to be used.

This flexible hose, developed and patented by Dunbar Kapple, Inc., has overcome the problems of turbulence and pressure drop heretofore common to corrugated metal hose.

It's now possible to have the strength and corrosion resistance of metal for use in free flowing, friction hydraulic, pneumatic or drain lines. Greater dependability and less deterioration are now attainable with flexible metal hose and during its place where synthetic and rubber hose usage is marginal.

because of excessive temperatures and pressures. And, it's at last flexible to reflect at high speeds with a long-lasting flexible metal hose.

Breath flow is assured by special fabrication. An outside retaining braid gives added strength. The flexible metal hose will stand pressures from vacuum to 1330 p.s.i. and up. Inside diameter one 1/2 inch to 6 inches and up with lengths from 1 inch to 100 feet.

For further information... write in confidence to Bureau at Dunbar Engineering, 2305 Grand Avenue, Kansas City, 2140 Westwood Boulevard, Los Angeles, C. F. Hamel & Company, 246 4th Avenue, Bay Shore, Long Island. Your inquiry will receive prompt attention.

DUNBAR KAPPLE, INC.

A Subsidiary of General American Industries, Inc.

AIRCRAFT COMPONENTS DIVISION

1201 Island Avenue - Evanston, Illinois



over contacts with which the government has an industrial security contract."

• Abolition of the "confidential" classification for all future documents. Documents already classified "confidential" should be made available to defense engineers without clearance. Later, there would be a gradual move for the declassification of the documents.

Declaring that the classification of "secret" and "top secret" is adequate to protect the national security, the commission said that some documents now classified as "confidential" could be so classified only by the greatest attack of the imagination. It noted that 99% of all of the classified material of Department of Defense is now listed in this category.

Any wholesale upping of "confidential" documents, the commission said, would be adequate of persons "gross delusions" in classification. It added:

"Only a few men are capable of upping

ing of documents would be necessary. Any man involved in the abolition of "confidential," so far as the industrial security program is concerned, is vitiated by the fact that the various industrial phases of a confidential contract are so dispersed as to make it virtually impossible for any employer to assemble the information for the detriment of national security."

The commission also declared that there should be no censoring whatever of industrial information. It included the recent abolition of Commerce Department's Office of Strategic Information established to control the flow of unclassified technical information, observing: "Except in time of war there should be no agency of governmental censoring, excluding information and materials. It is unrealistic to believe that technical publications and catalogs of American industry, available to the public in the U.S., would not be available to agents of foreign governments."

Navy Wants Industry to Share Burden of Solion Development

By James Foye

Washington—Exploitation by industry of Solion, a new and versatile form of electronic components, is being urged by the Naval Ordnance Laboratory.

Creation of a commercial market for these electronic devices, whose operation is based on the movement of ions in a solution, will accelerate their development, lower costs and increase availability to the Navy, the Laboratory believes.

Solion, the name a contraction of "ions in solution," will function as transducers and control elements throughout a wide range of applications, according to Navy planners. "They are said to be lightweight and highly resistant to temperature, pressure, light, sound or vibration."

One type of Solion, an integrator called the rate of a derivative rate, may permit maps, cues, weight and cue indicating for air navigation and aerial guidance systems.

A navigation system designed to use electrochemical integration would be capable of detecting incoming direction of the original course, which would permit a pilot or missile guidance system to correct quickly any deviation

One of the earliest integrated units for the Solion technology is for a visual indicator meter to predict personnel working near jet aircraft. Exposure to the low frequency magnetic fields of jet engines over an extended period can cause dizziness. The device would measure the cumulative effects of the sound and visual aids, which are used close by a change in color of the indicator.

The general area of application:

- Rate elements of all frequency spectra operated from transducers, sensors, detectors or other sensors.
- Integration units requiring continuous output of high precision or over long periods.
- Product units involving either electrochemical or electrostatic flow.
- Electrochemical and signal amplifiers.

Basic research on the Solion technology has been performed by the Naval Ordnance Laboratory and the Defense Research Group of the University of Texas.

Several of the staff members of the Defense Research Group have formed a company (Texas Research Associates Corp., Austin, Texas) and are presently seeking contracts from industry to develop Solion devices for commercial applications.

All of the several different Solion types depend upon the movement of ions (electrons) charged down or under a solution, instead of in a vacuum or gas in the vacuum tube, as in a solid state transistor.

The integrator unit is typical of the seven or eight types of Solion presently developed. It consists of a small electrolytic cell divided into two sections by a porous ceramic filter. Two electrodes are immersed in a solution of potassium iodide to which a small amount of iodine has been added. A low voltage battery supplies a small amount of slightly less than one volt. Its electrostatic action, the concentration of iodine as one chamber of the cylinder will change as iodine, which cannot penetrate the filter, is converted to iodide, which can. As potassium iodide increases in one section, iodine plate with an increase in the iodine concentration.

News Digest

Lockheed C-130 Hercules will be tested this summer by Marine Corps as possible tanker for night air support. Lockheed's Hercules Division has been given a contract to supply the USAF to conduct an analysis for the tests at Princeton, Md. A second analysis will be tested by Marines as a troop cargo transporter.

Weight waste demand for jet aircraft fuel now is higher than that for transport gasoline, California Texas Oil Co. reports. In the last five years, world demand for jet fuel rose from 15 to 100 million barrels a year, but jet fuel consumption rose only 40%, from 50 to 70 million barrels.

Sale Aircraft Co., which ran jet losses last year, has a strike and production shifts, ended its fiscal year April 30 with a \$18,981 profit, equal to 55 cents a share. Last year the company earned \$1,312,908 or 58 1/2 cents a share for the fiscal year ended April 30, with a net loss of \$1,000,000, or 40 cents a share. Rockwell was \$80 million of the year's end.

West Aircraft Co.'s X-11 Y-11 jet is being transferred from Edwards Air Force Base to an eastern USAF base by ship via the Panama Canal. Test pilot Pete Guard is due to go on the test flights as well. In the meantime, two USAF ATTC test pilots are starting VTO training at the latter jet at Reno's Max Baer pilot preparation to checkout in the X-11 itself.

Northrop Aircraft, Inc. earned \$1,313,334, equal to \$6 cents a common share, in three months ended April 30. For the same period last year, earnings were \$1,174,614 or 74 cents a share. For the 1955 three months period, earnings were less than last year, \$60 million compared with \$85 million.

publicize about any new source on the route getting underway to operate over the Los Angeles-San Francisco link.

Southern Airways has proposed that it be awarded a closed door negotiation as a basis either to offer the separate route to San Francisco and Los Angeles similar to American's present authority. Confirmation of separate routes to the two California points could conceivably encourage the

CAB to make two new routes for Delta-West service—one for each of the routes.

Trans World Airlines and United Air Lines took part in the hearings, although neither has an application to the case. Both TWA and United were denying their right in the Los Angeles-San Francisco market. TWA also declined to service at some of the intermediate points between Dallas and California.

SAS Order for 6 Caravelles, Options for 19 Is Reported

Trans-Canada Airlines System is reported ready to order six two-jet Caravelle transports and to option 19 more.

The French jet returned home June 24 on the North Atlantic after completing a sales tour of South and North America which began May 7 and included 94 demonstration flights with 1,800 passengers carried. No final order was announced as a result of the 27,750 mile tour, but firm sources report the SAS order to match off a string of orders pending on both sides of the Atlantic.

U.S. Order

The six SAS Caravelles would be delivered during the first half of 1959. This would mean Air France—the only announced Caravelle buyer, with 12 ordered and 12 optioned—probably will have to face over sales of its planes to SAS. Air France's initial Caravelle scheduled for delivery in early 1959.

It is understood an agreement has been signed between Air France and SAS covering acquisition of the six on the French-Canadian run.

Convair's U.S. tour covered 17

cities and the plane was inspected by officials of most scheduled airlines in the country. Pacific Southwest Airlines is expected to order two Caravelles, option six within the next two or three months for West Coast operation.

Viac, a British airline, said it planned to order five Caravelles.

U.S. Tour

The French jet returned to life mid June 19 and flew two kind U.S. demonstration flights, arriving at airports of Kansas, Air Lines and American Airlines. The plane went on to Montreal for Trans Canada Airlines negotiation, then returned to Oshkosh after a stop at Gander.

The 7-000-mile flight from Gander was accomplished in six hours, 20 minutes and put the plane back where it was stored within minutes of the original schedule for the winter of the year.

Convair's sole trip to Gander City, Calif., for inspection by Howard Hughes, touched off reports that Hughes would build the plane in this country, but no acknowledgment of such negotiations was made by Sud Aviation.

Charles F. Tronzo, Sud general representative for North America, said during the Convair's West Coast tour that Republic Aviation would build the plane if enough orders were obtained in this country.

Four per Month

Convair production will reach at least four aircraft monthly by the beginning of 1960, according to Sud Aviation President Georges Herli. At least 15 of the aircraft are expected to be built in 1959.

An agreement has been signed between Sud Aviation and Fiat of Italy under which the Italian firm will participate in Convair production. Such an agreement was expected to have been signed with other European manufacturers.

Argentine Line Seeks Route to New York

Washington—Civil Aeronautics Board Economic Fairness Board has not recommended approval of an application by the Argentine Airlines (Aerolineas Argentinas), S. A., to operate scheduled service between Argentina and New York under a bilateral agreement signed with California Eastern.

In its opinion, the airline requests to operate the route with a fleet of three Lockheed 1049H Constellations which have been made available under the terms of a lease purchase agreement with California Eastern.

The airline also has five Convair 580 jet transports on order (AW Oct. 29, 1958, p. 42; Nov. 26, p. 37).

Under the terms of the agreement, Transcontinental Airlines will provide the second aircraft for the California Eastern for 60 months. This assistance will include arrangements for the operation, maintenance and overhaul of aircraft until those functions can be handled by Transcontinental.

As consideration for the technical assistance provided, the airline proposes to lease a 25% stock interest in California Eastern. The arrangement provides for no expense permitting California Eastern to purchase enough stock to maintain its 35% ownership in the joint Transcontinental venture to increase the number of shares outstanding.

In its application, the airline says technical and management assistance needed to conduct operations of the line and scope of the proposed to not include in Argentina. It added that it California Eastern is suit prepared to collaborate in the development of the proposed route, the airline would transfer office from Buenos Aires to New York. Sud Aviation is the sole manager from Argentina, Air France is the sole manager from France and Royal Overseas Airways Corp. is the manager in London.

Transcontinental is favored and opposed as a private enterprise, according to the CAB member. At present, Aerolineas Argentinas, a wholly-owned government airline, operates service to New York from Buenos Aires and transatlantic flights to Europe from Argentina.

Transcontinental proposes to re-negotiate the New York service with that country's airline.

It estimates that traffic will average 68 passengers per flight, or 68,720 passengers per year.

The three Lockheed Constellations will be equipped with a configuration of 52 seats and then still. Cargo in the flight will be provided by California Eastern.

Player to Leave ATA

Washington—Wallo Player has made a decision to leave the Air Transport Association and to accept public relations to accept a similar position with American Airlines. He will be succeeded by John F. Hoving who has been elected vice president of public relations by the ATA Board of Directors. Player's sale with American Airlines has not yet been determined, but he will take over his new position at New York City in September. He joined ATA in 1954 after having served as vice president of public relations with Northeast Airlines and earlier as public relations director of Pan American Airways.

Player, 51, joined ATA in May, 1956, and has been serving as director of public relations. Previously, he was a partner in the New York City public relations firm of Peacock, Cook & Hoving. He also has served as assistant to the chairman of the Democratic National Committee.



TWA Is Replacing Hollow Blade Props

Hollow Blade Hamilton Standard #HH50 propellers on TWA's Lockheed 1049A Jetstreams that are being replaced by solid steel blades following a recent weld failure of a hollow blade.

The weld failed shortly after takeoff of TWA Flight 952 en route to Miami from Pease. Following the failure, a portion of the blade filler was flung from the tip along and penetrated the engine cowl at the propeller. The engine was shut down and the flight returned to Ohio.

The airline is studying possible or new to the hollow aluminum blade, which offers a slightly plus weight advantage over the solid version. Solid blade is backup equipment for 3549 operations. Hollow blade is standard.

Correction

Washington—Civil Aeronautics Board has not decided that a case and desert order be issued against Trans-Canada Airlines Agency Corp. is reported by Aviation Week (June 10, p. 47).

Proposed that such an order be issued against the agency was made by Bureau Counsel Edwin F. Strubbs, but the Board has not taken action on the recommendation. Strubbs's proposal is now being reviewed by a CAB instance who will report his findings to the Board.

The list of alleged violations of the Civil Aeronautics Act by Trans-Canada is not taken action by the Bureau Counsel and not by the CAB as reported by Aviation Week. American West reports the case.



Russian Transports

Douglas DC-4 (top) in flight and in production. Soviet transport is powered by two 2,600 hp. ASh-62T, 14-cylinder, radial aircraft engines. Standard seating accommodations 27 passengers. Larger Beriev 12 (note nose, below) will carry 70 passengers, has a low-mounted wing and four turbo-prop engines (AW July 2, 1958, p. 26).



American Airlines Recommended For Chicago-Mexico City Route

Washington-American Airlines was recommended last week by Civil Aeronautics Board members John A. Cox and John A. Manning to operate the Chicago and Mexico City routes under the U.S.-Mexico air transport agreement signed this spring (AW March 18, p. 41). Both American and Braniff Airlines sought this route.

The recommendation, which was made to the Board orally, in turn, will make its recommendations to the President for final approval.

American now holds a permit from the Mexican government to operate between Dallas, Fort Worth, San Antonio and Mexico City and has been operating such service since September, 1942.

Braniff also has been committed to provide service between San Antonio, Laredo and Mexico City but has been unable to explain the service because of lack of authority from Mexico. Neither has authority to fly between Chicago and Mexico City, though both could operate through service via intermediate points.

Even though the Mexican air agency recently said that U.S. carriers to be designated for each of the seven routes, Braniff's attorneys recommended that Braniff's certificate remain in force as the event more than one carrier can eventually obtain authority to conduct U.S.-Mexico operations over the route.

The only other route agreed upon under the Mexican bilateral still goes to the New York-Washington-Mexico City route. In this instance, pending before the Board, Pan American World Airways has been recommended over Eastern Air Lines.

Airlines already designated for routes are:

- **Western Airlines** to operate between Los Angeles and Mexico City via intermediate points in the U.S.
- **Eastern Air Lines** to serve between New Orleans and Mexico City.
- **Pan American** to operate between New Orleans-Mexico and between Los Angeles and beyond.
- **Pan American** to operate between Miami-Mexico and beyond, to Guatemala and beyond.
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In recommending American for the route, Executive Council said: "During the 15 years of operating in Mexican waters, American had done much to bring good will to the U.S. in Mexico

"There is no reason to believe Braniff could not establish good relationships in Mexico and during the course of more development and other activities comparable to American. The fact remains that American is an established airline in Mexico City, having extensive facilities and good will all of which would be lost if its operations are terminated."

"At the very least, termination of its traffic would result in some losses in service and traffic until the new carrier is able to take the most efficient and build up its organization. In view of the foregoing considerations, it is concluded that the public interest could be best served by selecting American to provide service over this route."

Swiss Vote Clouds Swissair Jet Plans

Geneva-Zürich's Kloten Airport expansion, geared to the introduction of jet transports by Swissair in 1979, has been held down by a referendum on jets in a public national referendum.

Plans called for the expenditure of \$14.5 million over the next five years to lengthen the runway and provide new terminal maintenance and overhaul facilities for Swissair.

Defeat of the referendum by a large vote was expected by both government and airline officials, as the last \$18 million in construction contracts was made to let immediately.

Swissair's government report for its traffic in 1976 before the referendum that refusal of the proposal by voters would mean that the airport would be able to retain only conventional traffic. Language flights primarily from across the Atlantic would have to go elsewhere.

Swissair, one of the top producers of aircraft for Switzerland, says it will not be possible to schedule some of its scheduled routes out of Zürich which now has in 5,500 jet instrument hours. There would be one-stop flights going from Zürich to Geneva or Zurich-Europarc City. But nonstop transatlantic flights will pose a problem which the airline has been studying, as a through extension of its flight scheduling for the future.

Most part of the plan was the provision of new facilities for Swissair at Zürich. The airline's report of results, Kloten is now the headquarters and operations base for the airline. Present operations are inadequate for jet maintenance and will have to be replaced by a new

terminal with the addition of lounge space, shops, cafeterias, and school facilities. Cost of the new facilities was estimated at \$11.6 million.

Defeat of the proposed expansion means that Swissair could not have an aircraft terminal in its future position of jet overhaul and maintenance. Upgrading of the base in Geneva, the country's second largest airport, is now primarily carrying through its expansion program, some to be completed by 1979. But some observers believe that Zürich would not be able to meet its need to keep flying, since the airline plans to use the new jet maintenance facilities.

There is also the possibility that because of the expansion, which may cause their place in the air, for a single runway, the airline will have to use a second of using for the construction of the complete landing in a new.

About one-third of the world's funds were to have been supplied by the nation of Zürich's own funds, the rest coming from the Swiss federal government. Most airlines agree that the vote was not so much against the use of money for expansion of the airport as it was an effort to keep money in Switzerland and avoid the loss of Zürich. A large feature also left the airport funds should be voted on a step-by-step basis rather than all in one.

Factors around the airport whose lead would be brought for revenue customers would be required at the time, but they could not be expected to accept. First, lead in one part of the airport would be required, and second, the airport would be required to accept the lead in one part of the airport.

Britannia Confirmed As Aeronaves Choice

Purchase of two British Britannia by Aeromexico de Mexico has been announced by British, confirming an Aeromexico report that the airline had ordered the British helicopters several months ago (AW June 1, p. 41).

Aeromexico will use the 100-ton Britannia in its newly announced New York route. Reported value of the order is \$8 million. The planes scheduled for delivery this year are being completed at Short Brothers and Harland, a British aircraft manufacturer in Belfast, Northern Ireland. The two Britannias were ordered by British Overseas Airways Corp. and replacements will be delivered later to BOAC.

Order brings total Britannia sales to 20. The Britannia is a British aircraft designed primarily for jet service. The Britannia is a British aircraft designed primarily for jet service. The Britannia is a British aircraft designed primarily for jet service.

Local Lines Push Guaranteed Loan Plan

By Fred Ertman

Washington-Government guaranteed loans to help finance new equipment would minimize one of the most serious problems now facing local service airlines.

Current difficulties in obtaining financing for new equipment were outlined last week before the Senate Interstate and Foreign Commerce Committee for hearing hearings on Senate Bill 2279 which would give guaranteed loans to airlines to provide loans to airlines for the purchase of aircraft and related equipment.

It is one of the four methods which Congress designed to aid the local service industry.

Other bills out to be considered by congressional committees are:

- **Capital gains bill** which would permit airlines to get stock profits from the sale of equipment to be used for the purchase of new equipment rather than using it as an asset against income.
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Other bills out to be considered by congressional committees are:

Local Lines Push Guaranteed Loan Plan

By Fred Ertman

Washington-Government guaranteed loans to help finance new equipment would minimize one of the most serious problems now facing local service airlines.

Current difficulties in obtaining financing for new equipment were outlined last week before the Senate Interstate and Foreign Commerce Committee for hearing hearings on Senate Bill 2279 which would give guaranteed loans to airlines to provide loans to airlines for the purchase of aircraft and related equipment.

It is one of the four methods which Congress designed to aid the local service industry.

Other bills out to be considered by congressional committees are:

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Other bills out to be considered by congressional committees are:

Airline Income and Expenses—April, 1957

(In Dollars)

	Passenger Revenue	Fuel Revenue	Baggage Revenue	Freight Revenue	Total Operating Revenue	Total Operating Expenses	Net Operating Income (Before Taxes)
DOMESTIC TRAFFIC							
American	\$1,002,293	\$71,464	\$61,376	\$1,079,359	\$4,490,401	\$3,112,723	\$1,377,678
Boeing	4,209,413	364,499	264,424	4,838,336	20,127,122	14,272,443	5,854,679
Capital	7,107,283	142,320	46,420	7,300,343	7,339,621	7,414,899	(75,258)
Continental	1,428,231	30,210	13,040	1,471,481	3,466,584	3,599,400	(132,816)
Delta	4,294,381	115,360	49,791	4,459,532	17,854,100	17,000,000	854,100
Eastern	31,280,449	884,891	367,340	32,532,680	23,314,204	23,340,873	3,191,807
Midwest	3,570,287	81,260	20,710	3,672,257	3,866,120	3,698,100	168,020
Norfolk	2,760,281	43,787	18,433	2,822,501	4,711,414	4,791,379	(69,878)
Norfolk	1,480,534	167,444	163,810	1,811,788	3,370,892	4,370,134	(1,000,242)
Trans World	18,450,723	392,228	121,723	18,964,674	10,612,224	10,520,886	90,338
United	18,279,338	73,280	248,230	18,599,848	26,344,008	26,690,100	(346,092)
Western	3,109,154	84,161	30,000	3,223,315	3,078,808	3,175,223	(96,415)
INTERNATIONAL							
American	429,823	1,471	134	431,428	419,244	449,556	(18,128)
Boeing	4,475,401	66,499	33,000	4,574,900	444,419	47,712	40,707
Boeing-Alaska	147,814	1,315	5,632	154,761	191,374	197,974	(3,200)
Delta	107,720	1,432	—	109,152	444,261	444,606	(344)
Eastern	1,170,744	33,495	10,494	1,214,733	3,160,334	3,097,160	63,174
Midwest	1,190,108	667,119	278,021	2,135,248	3,222,497	3,264,863	(39,365)
Norfolk	192,800	79,009	—	271,809	365,108	400,000	(33,892)
Norfolk	6,291,886	176,000	416,000	6,883,886	10,184,102	9,996,000	188,102
South America	2,363,800	767,000	191,000	3,321,800	7,317,464	7,496,000	(178,536)
Pacific	4,542,300	601,000	606,000	5,749,300	6,709,908	6,515,000	194,908
Panama	1,360,000	87,000	—	1,447,000	2,777,100	2,667,000	110,100
Trans World	3,215,740	473,230	276,000	3,964,970	4,394,400	4,364,100	30,300
United	627,363	28,432	—	655,795	494,937	492,911	2,026
LOCAL SERVICES							
Alaska	391,091	5,270	9,284	405,645	737,407	689,191	48,216
Boeing	141,497	2,640	1,267	145,404	143,470	143,470	—
Capital	104,168	8,449	933	113,550	89,701	240,287	(150,586)
Delta	310,170	1,759	—	311,929	318,370	316,921	1,449
Eastern	111,190	2,149	4,612	117,951	307,166	306,500	666
Midwest	111,240	14,164	7,761	133,165	440,121	472,224	(32,103)
Norfolk	369,368	480,216	7,564	7,191	770,812	800,103	(29,291)
Panama	429,709	6,227	5,261	441,297	646,461	660,264	(13,797)
Pacific	145,707	6,340	5,234	157,281	360,367	367,967	(7,600)
South America	216,474	2,412	4,007	223,893	448,404	448,970	(566)
Trans World	231,148	5,495	9,361	245,904	346,871	351,183	(4,312)
United	176,640	8,879	1,333	186,852	385,107	386,704	(1,597)
MAILS							
Boeing	202,600	3,360	—	205,960	476,400	476,700	(300)
Trans World	104,070	1,101	5,734	110,905	190,367	171,207	19,160
CARGO LINES							
American	10,100	—	—	10,100	146,760	146,760	—
Boeing	10,100	—	—	10,100	3,490,000	3,490,000	—
Capital	10,100	—	—	10,100	274,440	274,440	—
Continental	10,100	—	—	10,100	2,300,000	2,300,000	—
Delta	10,100	—	—	10,100	1,714,000	1,714,000	—
Eastern	10,100	—	—	10,100	1,714,000	1,714,000	—
Midwest	10,100	—	—	10,100	1,714,000	1,714,000	—
Norfolk	10,100	—	—	10,100	1,714,000	1,714,000	—
Pacific	10,100	—	—	10,100	1,714,000	1,714,000	—
South America	10,100	—	—	10,100	1,714,000	1,714,000	—
Trans World	10,100	—	—	10,100	1,714,000	1,714,000	—
United	10,100	—	—	10,100	1,714,000	1,714,000	—
Western	10,100	—	—	10,100	1,714,000	1,714,000	—
HELICOPTER							
Boeing	10,100	—	—	10,100	1,714,000	1,714,000	—
Capital	10,100	—	—	10,100	1,714,000	1,714,000	—
Continental	10,100	—	—	10,100	1,714,000	1,714,000	—
Delta	10,100	—	—	10,100	1,714,000	1,714,000	—
Eastern	10,100	—	—	10,100	1,714,000	1,714,000	—
Midwest	10,100	—	—	10,100	1,714,000	1,714,000	—
Norfolk	10,100	—	—	10,100	1,714,000	1,714,000	—
Pacific	10,100	—	—	10,100	1,714,000	1,714,000	—
South America	10,100	—	—	10,100	1,714,000	1,714,000	—
Trans World	10,100	—	—	10,100	1,714,000	1,714,000	—
United	10,100	—	—	10,100	1,714,000	1,714,000	—
Western	10,100	—	—	10,100	1,714,000	1,714,000	—

* Not available. ** Total property, expense, flight, charter and other. Compiled by AVIATION WEEK from reports to the Civil Aeronautics Board.

† System reports.

SHORTLINES

►United Air Lines will begin daily nonstop, McGovern Douglas DC-6B service on each service between Chicago and Los Angeles on July 1. The new service also will provide additional secondary service between New York and Chicago. Flights will leave New York at 10:50 a. m. and are scheduled to arrive in Chicago at 12:25 p. m. EDT and Los Angeles at 5:25 p. m. EDT. The eastbound flight will leave Los Angeles at 11:55 a. m. with scheduled arrival at Chicago at 7:15 p. m. and New York at 11:37 p. m.

►British Overseas Airways Corp. will introduce the British Britannia turboprop transport on the carrier's London Tokyo route on July 16. BOAC says the aircraft will not be true to specifications if it loses the eastbound flights and 44 hours the westbound flight. BOAC has been using Lockheed Constellation and Argonaut on the route. Constellation's London Tokyo schedule is 47 hours eastbound, 50 hours westbound. The Argonaut's schedule calls for 72 and 68 hours respectively.

►Bois-Armore of Montreal has increased its order from three to four Lockheed 1049H Super Constellation as a cost of approximately 150 million. The four aircraft will be used on the airline's Chicago-Montreal-Paris route on a six weekdays weekly basis. Delivery will begin in December and continue through March.

►Solomon Islander Week Airlines carried the 100,000th passenger on its international helicopter service on June 18. The passenger was Belgium Airs founder Jo Gennery Baron Nève de Greef.

►Seattle-Tacoma International Airport handled a total of 197,715 passengers in May, compared with 197,705 during May last year. Annual total 3,495,650 is in comparison with 3,536,646 in last year. Air freight dropped from 3,112,412 in May, 1956, to 3,095,592 in May, 1957. Total 1957 is 391,390 and first-class mail was down from 193,652 in 1956, 1957.

►Western Air Lines will begin daily nonstop Douglas DC-6B service between Los Angeles and Mexico City on July 15. The new flights will be staffed with pilots and stewardesses trained for bilingual operation. Western is co-sponsoring a survey of sales centers in Mexico City under the direction of Western technicians.

AIRLINE OBSERVER

►Planned suspension of three Boston-Baltimore turbotrip transports on Northeast Airlines New York-Boston route will be delayed beyond the early fall flight due because of Civil Aeronautics Board refusal to grant the airline a 90-day waiver on landing gear "prolong" requirements. Last week, the Board ruled that Northeast could comply with type certificate provisions requiring aircraft to "get about on one side of the main gear, the brakes on that side being locked" before the Britannia was placed in to service. Board has said the substantial modifications necessary to fully meet the panel last requirements will delay construction of the Britannia on Northeast's route beyond the "waiver" grace period. Northeast asked for the 90-day waiver in order to get the first three of five Britannia on order in service as originally planned.

►Air Line Pilots Assn. and the International Assn. of Machinists have signed a preliminary and mutual non-strike pact as part of a cooperative program "to raise wages and improve working conditions for airline employees." The agreement provides for close coordination in settling any disputes between the two unions and calls for mutual assistance in disputes between the two unions and either one of the unions. The two unions then represent approximately 30,000 of the estimated 122,000 persons now employed by the scheduled airlines.

►Card Aeronautics Board hearings on a possible control over traveling Air Corps, Northeast Airlines, Trans World Airlines and Howard Hughes will be held in New York on July 5. A CAB investigation is being held to determine whether acquisition of an interest in the Air Corps, which controls Northeast Airlines, by Howard Hughes, wife owner of the Hughes Tool Co. which controls TWA, is a transaction requiring CAB approval of common control of assets.

►American Airlines President C. R. Smith has proposed to the Civil Aeronautics Board a reduction of the fuelly fee amount by 70% and the elimination of nonstop, circle and overpass discounts, free stopovers and extremely discount tickets. Smith called the proposed 6% fee increase non-fair and said American will be badly providing for such an increase if the rate is approved by the Board.

►CNA, Czechoslovakian national airline, has taken delivery on the first of four four-engine Aero 14 transports it has on order. Aero 14 is a Czech-built version of the Soviet Dushka 14 and is built under license by Aero at Ljubanitz near Prague. The first Aero 14s are the first transport aircraft built in Czechoslovakia since World War II.

►American Airlines' reaction to an immediate decision in the Capital Airlines Family Plan Case has been described by the Civil Aeronautics Board. Last week, the Board announced that it would decide a decision on Capital's request for an extension of the family plan to include holidays until a general investigation of family firm was completed.

►Col. Brent Belcher, USAF (ret.), a veteran Air Corps pilot and expert, has joined Renton Airlines as a vice president.

►Civil Aeronautics Administration will begin operation of the Los Angeles-Pasadena airway on the Grand Canyon on July 6. The new airway, Victor Airway 216, is based on VORs installed at Los Angeles, Daguerre, California, Valle, Arizona, Farmington, New Mexico, and Pueblo, Colorado where it ties in with Victor H running from Pueblo to New York City.

►Palatin International Airlines Inc. purchased two 1049H convertible cargo transports from Lockheed Aircraft Corp. with delivery scheduled early next year. Plans will start service in 90-passenger configuration with a possibility of later increasing capacity to 114 seats through its about seating.

►Australia government has voted Australian National Airways proposal to merge all airlines into a single government corporation.

S2F Design

By Russell Hovick

New York—Variants of the Grumman S2F carrier-based subsonic hunter/killer are being made to play an increasing number of roles in Navy's operational planning. Variants include the WF-2 early warning aircraft and the TF-1 tanker/transport. Other developments are well advanced.

Adaptation of an existing design to new uses is a well established practice in the Navy. Advantages of such are:

- New airplanes with common structure.
- Parts interchangeability between airplanes having different missions, reducing the number of spares which must be stocked aboard ships.
- Maximum utilization of maintenance and air crews. Reduction in the number of specialized and untransferable support organizations built around single designs reduces manpower requirements.

The S2F offered unusual opportunities for redesign. Grumman officials insist that the subsonic hunter for which it was designed is one of several which do not require a high performance airplane and numerous advantages favor the use of one basic airplane for as many non-high performance missions as possible. Because performance requirements are low, the rate of obsolescence due to technical advances in airframe and engine design is slower and there is less chance new designs would be superior enough to justify their much higher cost.

Operational Flexibility

Delicate and supporting classes which can be handled by a low performance family of airplanes are vital to the use of the offshore weapons which are the main striking arm of the carrier task force. Because all of its members can operate from ship, low performance aircraft carrier, the S2F-TF-WF family has considerable flexibility of employment.

Basic S2F reconnaissance plane equipped with MAD, sonobuoy, radio, bombing, torpedoes and depth charges has been in service since 1953 and is now being produced at the rate of seven per month. About 360 have been built. There is no reason to suppose that the S2F will soon be replaced as the standard carrier-based, subsonic hunter weapon. Present subsonic designs could not cope with a Russian attack, but the capability is caused not by the limita-

Sires Family of Economical Adaptations

tion of the airplane but by the limited range of present subsonic detection gear. There is reason to expect great improvement in this aspect in the near future.

First of the S2F adaptations was the TF-1 carrier-based tanker/transport having a deeper wing fuselage. Because of its larger internal volume, the TF-1 was the first upon which the unaccredited WF-2 was designed and will probably be the last for any further evolution. The TF-1 was conceived originally as an operational trainer for S2F pilots, but first experience with the ASW plane showed that there was too much thrust expected for a trainer version.

Quick Change

The TF-1 can be field changed in about an hour to any one of four or more configurations: patrol cargo, "special cargo," personnel or subsonic. The cargo versions have a part in the airborne carrier rapidly idea which is being proposed increasingly by the Navy. The purpose of the structural assembly plan is to extend the time which a carrier can operate away from its surface logistics organization. Combat time without surface supply is now limited to 3-5 days. Drugging in such all-the-shelf items would make available more space aboard ship for stores which are not so transportable. As supply of soldiers and their orders is possible to spread three thousand in the fleet while keeping a flexible constantly loaded reserve. Another obvious advantage is that air supply bases are less vulnerable to enemy destruction. The TF-1 carries 3,500 lb. of cargo and operates off CVDs at an maximum gross weight. It solves associated problems from faster than carriers with only 2 1/2 ft. of head over the deck. This would indicate that some sort of countermeasures on attack carrier could launch and recover TFs without changing course if an enemy threat made this necessary.

Maximum permissible floor loading is 200 lb. sq. ft. The floor is high strength until kamikaze and is not damaged by the use of wheeled dollies without protective mats. The floor and cargo restraints are stored for 28 G crash loads and can withstand aerial loadings and catapult shots.

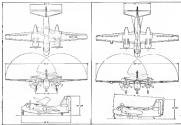
The cabin entrance is a two piece door. The passenger section is opened and closed by the main hatch and both. The cargo door is an integral

part of the fuselage structure and is held in place by six bolts. It can be removed in about 15 minutes to open a 70 ft. x 67 ft. doorway. The door sits a 24 in. above the deck.

Cargo is restrained by a rigid cage which Grumman engineers judged superior to the more common barrier web for carrier transports. The extended front beam and built-up banana cage sections can be assembled to fit the cargo. The members are secured by quick disconnect pins which

do not require the use of tools for assembly or disassembly. The seven longitudinal members are permanent track tracks in the floor and removable beams close in the ceiling. The horizontal webs of the upper rails are partitioned to receive the upper ends of box section verticals. The lower ends of the verticals are secured to fittings spaced at 2 m. intervals in the floor rails.

Four heavy I-beam stiffeners form the vertical corners of the cage. The



THREE VIEWS OF TF-2 (left) and S2F-1 shows variation in fuselage, tail section.



CABIN INTERIOR, looking forward in TF-1, low knee post, six stowboard off during flight.



FIGURE OF A FAMILY, Grumman S2F began its design for Navy subsonic airplane.



FIGURE ADAPTATION of the design, TF-1 export/transport, has larger internal volume.

EARLY WARNING WF-2 below, based on TF-1, took only one hour from design board to flight.

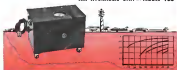


COMPACT AND EFFICIENT HYDRAULIC POWER UNITS

FOR APPLICATIONS TO 3000 PSI

The operating characteristics are interesting and one or both of these units may be able to do a specific job for you. Each unit is completely proven and has been skillfully designed for varied utilization, low cost, simplicity of operation and maintenance, and ease of transportation.

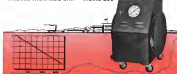
AIR HYDRAULIC UNIT — MODEL 100



This unit is explosion proof and features a demand system with constant pressure to 3000 psi. Pressure is accurately adjustable to 15 psi. The system is filtered and is powered by a pressure light, for hydraulic power pump incorporating an automatically operated solenoid valve. All parts are completely available.

SPECIFICATIONS:
Dimensions—17½" x 11½" x 14" high
Weight—20 pounds
5½" pressure and return lines, ¾" oil supply line and 1 gallon reservoir.

ELECTRIC HYDRAULIC UNIT — MODEL 200



This 110V ac or dc unit features a demand system with constant pressure to 3000 psi. Pressure is accurately adjustable to 15 psi. The system is filtered and is powered by a high speed, high efficiency gear pump. All parts are completely available.

SPECIFICATIONS:
Dimensions—14½" x 14½" x 31" high
Weight—30 pounds
5½" pressure and return lines, 110V ac or dc power, 1 gallon reservoir and 5½" Ag, 1½" hose.

Both of these units may be modified to conform to customer specifications.

ALCOA RIVET TOOL COMPANY
1001 WEST 14TH STREET • TORRANCE, CALIFORNIA

WRITE FOR
COMPLETE DATA

Nuclear Batteries Studied by ARDC

Los Angeles—Wright Air Development Center is studying development of lightweight nuclear batteries for use in secondary power sources in space aircraft.

The need for such a battery, or similar lightweight self-contained secondary power sources for instruments and other components, was recently outlined by Lt. Gen. Thomas S. Power, commander of the Air Research and Development Command, at the national seminar meeting of the Institute of the Aeronautical Sciences (another possibility under study, Gas Power and, as a practical means for generating solar radio thermal energy).

Presented by Gen. Power to USAF's research and development effort into space technology include:

- Solar radiation. To broaden the "leveled knowledge" on solar radiation, the permanent force behind physical and chemical events in the atmosphere, Air Force Office of Science Research and the Cambridge Air Research Center have awarded study contracts to several universities. ARDC's Upper Air Observatory at Sacramento Peak, N. M., is attempting to determine the effect of solar disturbances in the atmosphere and radio cosmic radiation.

- Nature and variations of cosmic radiation are being studied for USAF at the University of Chicago and Maryland. Investigations of the biological effects of cosmic radiation at Holloman Air Development Center have included tests with animals carried aloft by light



British Flyco Gas Turbine Helicopter

Fourtype by British Warfield Works helicopter makes its first flight powered by Napier Gas-turbine engine. Weight, a slender 5,800 lbs. under boom, is first British helicopter to fly on turbine power.

altitude balloons for as long as 35 hours.

- Improved weather forecasting techniques.

- Number and nature of meteorites. Detailed information on this area, Gen. Power said, is required "not only for the design of man-made vehicles exposed to them but also because of their effect on the atmosphere and radio communications."

Bristol Helicopter Details Revealed

London—Recently released details of Bristol Aircraft's Type 112 helicopter powered by two Napier gas turbine engines reveal that the helicopter, capable of carrying from 10 to 25 troops and now in production for the Royal

Air Force, has a cruising speed of 120 kt. at a gross weight of 10,000 lb. The two Napier Gas-turbine 3 engines provide a power output located at 520 shp in two-engine operation. Maximum continuous power is 1,075 shp with a one hour power of 1,400 shp. Emergency power is given at 1,675 shp.

A new drawing that interconnecting the two engines provides single-engine safety by keeping the rotor in proper plane relationship and providing both rotors to be driven by one engine in an emergency.

Best reports that power characteristics of the turbine permit the helicopter to cruise at its maximum speed of 120 kt.

Without rotor, overall length is about 51 ft., height 17 ft., and width 15 ft. 9 in. The helicopter's main rotor



M122-418—Pressure 70" x 30" reading device 10" in. safety. Reads to 1600" psi in 10" working diameter. Pressure indicator reads to 2 inches of psi change in 100 psi.

Cut inspection time in half

with new Corbin
Coordinate Calipers

These compact, portable optical instruments permit making precise coordinate measurements in a vertical plane. The two dimensions are measured with one setting, which does not have to be repeated. Inspection time is cut in half and setting errors eliminated.

Versatile Corbin Coordinate Calipers are ideally suited for precision measurements on both objects, also objects of points in round, square, or cylindrical locations. Applications include measuring jet engine components, mechanical castings, grinded surfaces, bolt holes and bores on large cast parts, drawn cut controls, key slots, etc.

Because they are optical rather than mechanical measuring instruments, you make non destructive measurements without contact, scratching, or compressing pressure being applied to the object when making a setting. Instruments available in Rockwell or Metric systems.

M122-41—
Horizontal range 10"
Vertical range 10"
Scale to 1600"
in 100 psi



M122-33—

Range 2 1/2" x 1 1/2"
Scale to 100"
in 100 psi

Write for Bulletin 100-132

**The Gairtner
Scientific Corporation**
1001 Wilshire Ave., Chicago 14, Ill.
Telephone: WEdgeway 1-2022



Kistler Indicator Measures Engine Pressure Changes Quickly and Precisely

Featuring high sensitivity and accuracy, the new pressure-measuring Kistler SLM Engine Pressure Indicator has been designed for research, development, testing and evaluating aircraft, engines, gas jet, rocket and turbine engines. It is rapidly being adopted by the automotive, aircraft, marine and fuel industries.

Pressure changes producing an electrical charge in the piezoelectric SLM Pressure Pickup are measured by an electrometer circuit amplifier and displayed on an oscilloscope. Small pressure variations in overall cylinder diagrams can be magnified as much as a thousand times. Magnified enough to differentiate flame characteristics and other combustion up to 500° F, without special air or water cooling, the pickup will measure combustion pressures for all engines. It through solid jet for the addition of a Kistler adapter, fuel injection pressures to 20,000 psi can be measured.

The output of the SLM Indicator is accurate directly at low pressures or can be pressure changes, making it available for fuel, combustion and detonation studies, load balancing, monitoring, quick pressure adjustment, gasification engines, and maintenance or repair operations. The most advanced engine pressure available, it can be operated as readily as a TV set. Trouble shooting and location of injection timing are greatly simplified. Optional electronic coupler is selected which permits operation of several pressure pickups with a single amplifier/oscilloscope unit, and a pump-down device for direct display of traditional indicator diagrams.

For complete information on the SLM Pressure Indicator, including literature SLM Pickup, special low cost edition and the Kistler "Power-Calculator" (calculator-cum-oscilloscope), request Bulletin KPI-116.

Kistler Instrument Corp., Dept. 411, 15 Wilshire St., North Hollywood, N. Y.



First Sycamores for Germany

These two Sikorsky Sycamores have left Bristol Aircraft's factory and are bound for Westgate Germany. Helicopters, the first delivery of an order of 10, from German武裝, including the famous "Arktos" on full order.

length is 24 ft., height is 6 ft. 11 in., and width is 5 ft. 9 in. The two main blades extend have a diameter of 48 ft. 5 in. Maximum design rates open to 270 and maximum design rotational speed 657 H per hour. Fuel capacity is 573 U.S. gal.

Performance figures at 15,000 ft. include a service ceiling of 13,150 ft., hovering ceiling without ground effect of 6,000 ft., a vertical rate of climb on two engines of 700 ft. per min. and an emergency rate of climb with forward speed of 1,175 ft. per min. Optimum rate of climb on single engine with two engines power is 700 ft. per min.

Range 592 air miles, 23 armed troops at 215 lb. each plus a pilot at range of 130 loaded miles. Range of 700 air miles is provided for 12 stretches only and 1 sitting wounded. Altitude, 5,000 ft. of height can be carried over 125 loaded miles.

In search and rescue operation, personnel can be rescued in 10 minutes from the sea within a radius of 200 nautical miles, with fuel for 30 min. of hovering during rescue and rescue fuel consuming to 30% of the rated fuel load.

Extra links installed in the landing gear for ferrying can increase the stall air speed to 63 knots under. Navigation paratroops can be carried 115 miles.

Bristol says the 192 is fully equipped for day and night instrument flying, with additional provision for automatic pilot and dual controls.

It is equipped with a spring balanced door which can be opened and closed

in flight. A door capable of handling loads up to 600 lb. attached to the underside of the spread wing doors can be operated either by the pilot or a crew member.

Loads up to 5,150 lb. which cannot be carried by the rotor can be slung from a strong point beneath the fuselage.

International Air Group Is Founded

First world wide organization with the specific purpose of extending international aviation collaboration, an all arms participating to flight was formed May 10 in Paris by 18 nations. Known as the International Council of the

X-2 Altitude Confirmed

Los Angeles—Nine months after its launching, Gen. Thomas S. Power, commander of the Air Research and Development Command, has been permitted to check the flight record for September by Capt. Gene Koschke in the Bell X-2 for a new altitude record.

Conferring on Aviation Week report last Sept. 26 by 75, Gen. Power told the National Security Meeting of the Air Force of the American Society.

"Last year, Capt. Gene Koschke of AEDC's Air Force Flight Test Center flew the Bell X-2 rocket-powered test vehicle in an altitude which I can now confirm to have reached 126,100 ft."

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View of Rheem's Design facility showing the area now devoted to jet engine development.

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Long Stick Aids HOK Stability

Engine stick lengthened to carry gross from 15,000 to 25,000 lbs. of disk and improved longitudinal cyclic control and elevator control reduced rotor vibration in Sikorsky HO4S helicopter. Stick was fabricated to carry gross just each side of outer hub. Composite rotor was carried out with short stick, and gross shifted upward through aft edge of rotor disk produced more up trim moment sufficient to compensate forward cyclic control, and they reduced rotor vibration. Sikorsky will make further tests to develop disk to pass get through grossly through center of lift of the helicopter.

systems for Polaris, leading ultimately to a submarine launching system for the Navy submarine range ballistic missile.

Contact is with the Bureau of Ordnance.

The Westinghouse activity will be centered at its Sayreville, Calif., division facilities.

Polaris, which will have a 1,500-ton range, is being designed to fit from surface ships as well as submarines. The contract calls for development of engine mechanical and electrical systems for the launching of Polaris from either type vessel.

Production Begins of Lithium Oxidants

Two new oxidants for use in high energy fuel systems, lithium perchlorate and lithium nitrate, have been placed in production by American Potash & Chemical Corporation. The two chemicals will be used in solid propellant fuels.

Lithium compounds are attractive for propellant use because they have a high oxygen content on a weight basis. Lithium perchlorate has about 60% oxygen and lithium nitrate about 70%.

Ryan Acquires Plant At Torrance Airport

Ryan Aeronautical Co., San Diego, acquired an assembly plant and 27 acre industrial site adjacent to the Torrance Municipal Airport. Facilities contain 157,000 sq. ft. of floor space formerly occupied by National Electric Products Corp.

Torrance plant will be used primarily for assembly operations on new major projects at the Douglas DC-8 jet as well as other projects and plans, and the Ryan F4U jet drive on which the production rate for the military is being rapidly expanded.

All engineering and fabrication work on these and other projects assembled in the Los Angeles area plant will be performed in San Diego Torrance facility, combined with new factory facilities nearing completion at Azusa. San Diego plant, will house the company's total area under roof is 1,185,000 sq. ft.

Under construction at Azusa San Diego site are an Engineering Research and Development Center and a Tooling Fabrication building.

Setting up of equipment for the F4U jet assembly line is expected to get under way soon at the Torrance plant, with the DC-8 project to follow in a few months.

FACTS

about

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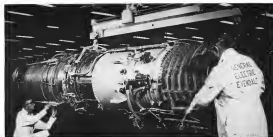
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J79 Utilizes Nozzle Vanes, Variable Stators



General Electric's Mark 2 turbojet, for J79, is shown during a factory check (top). The engine delivers considerably more than 15,000 lb. of thrust with afterburner, as more than 10,000 hp. of Mark 2, from a total engine weight of less than 5,200 lb. Guide vanes for idling extend on into the afterburner as visible above the base of the lowering mechanism. The air could be used for cooling unless it is aerodynamic means of varying the nozzle geometry which is necessary at supersonic speeds. Typical section of the J79's variable stator control linkage is shown being adjusted (bottom). One of the several power cylinders for linkage is at the top of the picture. How after burner nozzle shuts down for low speed operation is shown (right).

Civil Conway Rated At 16,500 Lb. Thrust

London—Tillott threat of the Rolls Royce civil Conway jet engine turbojet engine is rated 16,500 lb. The R. Co. 10 engine is more than 152 in. long and 41 inches in diameter. It has been selected for installation on 67 airliners, including Boeing 707s, Douglas DC-8s, and Vulcan VC-10s. Military variants are specified for the Hawkeye, F4 Phantom II, and Victor bombers.

PRODUCTION BRIEFING

Conway started installation of a 75-ton Civil Rolls-Royce jet for \$50 at transport package built from fabrication. Unit will arrive at Conway in September, will start production work in soon as ground tests are completed. From a 75 ft. long, 36 ft. wide, 12 ft. high, has a 150-in. diameter nozzle, table with 360 deg. rotation, and is hydraulically operated.

Douglas Aircraft Co. developed a new space engine for its DC-8 turbojet, turbojet and derivative, wherein packed cells and continuous scrape mechanism of engineering drawings are integrated to develop space fuel time and help achieve extreme rapidity with more closely. System is projected to be ready when first DC-8 is set ready for customers.

Hydraulic pump with side cover for complex fittings with undercuts in test-drafts has been placed in operation by Harley Aluminum Co. For use, Cold. Each side cover can exert 2,500 tons, main cover applies 4,000 tons. Red use between pressure steps in 70 in. from to back, 90 in. left to right, with daylight capacity ranging from 45 in. to 90 in. Split dies or one vertical ones can be used with side dies and main dies.

USAF contract for modification of existing engine, electronic control systems for all variables. Engines have been awarded Hughes Aircraft Co., Culver City. Contract value is \$1,071,216.

Loose sections for 25 Boeing 707 jet transports will be fabricated by Aerospace America Service Co. with first delivery in September of the year. Reminders of the looses, which are in two configurations, will be delivered by early 1973. The two configurations of four passengers each are two low and two high, and low as a crescent-shaped seat. Design, engineering and testing of the sections will be accomplished by Aerospace.

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PASSIVE RADAR, promising new detection, surveillance and mapping techniques, underwent only tests on Navy ships. Passive systems use radar for mapping and surveillance. Small distant antenna underneath was used for guidance tests.

Passive Radar Gives Infrared Technique

By Philip J. Klein

HANMER FIELD, Bedford, Mass.—Fundamentally new techniques for surveillance, mapping and cryptologic guidance which learn some similarity to both infrared and to radar, yet which often reflect advantages over each, has just been unveiled. It is called "passive microwave radiometry," or "passive radar" for short.

Like infrared, the new technique detects electromagnetic energy radiated by every object whose temperature is above absolute zero and it does not require the equipment skill to radiate energy as with conventional radar. However, passive radar operates at the lower frequencies than infrared, down to the familiar microwave radar region. Passive radar receiver techniques and components must closely resemble those used in active radar than those used for infrared.

AFCRG Techniques

Air Force Cambridge Research Center (AFCRC) here has sponsored the new technique, largely through its house investigations, according to Dr. Joseph P. Casey of AFRCG's Propagation Laboratory. Sperry Gyroscopic Control put a phase at the installation, under AFRCG sponsorship. Bell Telephone Laboratories recently are also active in the passive radar field, but not under AFRCG sponsorship.

A comparison of the characteristics of the new passive radar with those of active radar and infrared shows some

interesting advantages, some disadvantages.

- **No uplinked energy.** Unlike active radar, whose radiated energy gives away its existence and position, passive radar matches infrared in its security from detection.

- **Larger range.** Passive radar, located at operators at microwave frequencies which suffer less atmospheric attenuation, has greater range than infrared. At longer wavelengths, the 3 cm and 6 cm, passive radar experiences relatively little attenuation by rainfall.

However, compared to active radar, the new technique may have some vital limitations against some types of targets. • **Size, weight, complexity.** Present radar is smaller, lighter, less complex than a complete active radar because the former requires no transmitter. However, passive radar is somewhat larger, heavier and more complex than its equivalent-function infrared system. Because of the lower operating frequency, a passive radar antenna is larger than an infrared scanner, comparable to an active radar antenna at the same operating frequency.

- **Resolution.** Passive radar resolution is inherently inferior to infrared because of its lower operating frequency, and its basic principle of operation makes it inferior to an active radar in this respect. Yet passive radar's ability to discriminate between different types of targets and backgrounds can be as good as better than either infrared or active radar.

- **Response time.** Early experimental

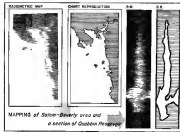
equipment used by AFRCG in its last experiments, which employed conventional superheterodyne receiver and components, had relatively low response time and scanning rates compared to active radar and some IR systems. However, use of new tunneling wave tube amplifiers in passive radar systems should provide a significant improvement in response time.

Other Air Research and Development Command centers are beginning to apply the new technique to specific hardware as AFRCG's basic studies shift to other areas.

How It Started

Passive radar techniques stem from World War II measurements of atmospheric absorption of K-band energy conducted at the Massachusetts Institute of Technology's Radiation Laboratory. Dr. H. Charney and associates, using an adaptation of ionospheric techniques previously developed for radio astronomy, chose to "detect" the antenna down to that of "leakage" at the ground control of the sky.

They discovered that microwave energy was being radiated from the ground and that it relatively varied when the antenna was pointed at different objects. This suggested the possibility of passive microwave radiometry. It was not, however, until about five years later when new microwave components and techniques appeared to make passive radar feasible, that AFRCG first began its investigations aimed at this specific objective.



PASSIVE RADAR maps, made with early experimental equipment, show elongate shape of same area, shows approximate geographical locations of techniques pioneered by AFRCG.

at Microwave Frequencies

Error object whose temperature exceeds absolute zero radiates electromagnetic energy not just in the infrared region but throughout the spectrum into lower frequencies. The bulk of the energy radiated occurs in the infrared region. (For example, nearly 95% of the energy radiated by a black body at a temperature of 27°C lies in the infrared region above 10 microns, only a fraction of one percent of the total energy is radiated in the microwave region.)

Emissivity

As in infrared, the perfect microwave emitter is an idealized black body which absorbs all microwave energy striking it, thereby producing maximum possible radiation in microwave region. Like infrared, the black body is used as a convenient reference. Also, emissivity is defined as the ratio of any object's radiation to that of an equivalent black body at the same temperature and shows it less than 100%. (An object's emissivity at IR frequencies can be quite different from its emissivity at microwave frequencies.)

A good black body temperature quickly is expressed in terms of equivalent black body temperature which is the product of its absolute temperature and its emissivity. Thus an object whose temperature is 300K and whose emissivity is .25% behaves like a black body radiator at 75K (15% of 300) and is said to have an equivalent temperature of 75K.

The microwave energy which a pas-

sive radar antenna receives when it looks at an object (assuming the object is large enough to fill the antenna beam) is the sum of radiation emitted directly as a result of the object's own temperature plus the microwave energy from the sky, or other sources, which is reflected from the object into the antenna's beam. The combination of these radiations is usually expressed in terms of "apparent black body temperature," sometimes in "equivalent ambient temperature," since this is the microwave radiations the receiver would see if the antenna were replaced by a standard loss black body at this temperature.

To illustrate, a body of water whose absolute temperature is 300K (27°C) and whose microwave emissivity is .95% will emit radiation equivalent to a black body whose temperature is 151K, or 180° F (80° C).

Sky Radiation

In addition, water reflects microwave energy from the sky whose temperature is 275K, or 19° F (253° K). But not all of this sky radiation is received; only 55% of it (180% minus water emissivity). Thus the amount of sky radiation absorbed is equivalent to a black body whose temperature is 275K, or 19° F (253° K).

A passive radar antenna aimed at the water would see the sum of these radiations so that the water would have an apparent black body temperature of 161° K, or 131° F (27° K).

Decrease passive radar sees both direct

AVIONICS

emission and the reflected radiation, it is able to discriminate between two objects which are at essentially the same temperature but which have different reflectivities.

For example, consider the problem of discriminating between water and ground which may be at roughly the same temperature. Whereas water may have an emissivity of 45% and reflectivity of 55%, the figures for ground are approximately 90% and 10%, respectively.

The apparent black body temperature of ground at 300K is then by passive radar, would be equal to (180°/0.90) + (19°/0.05), or approximately 275K. This is 112° K higher than the apparent black body temperature of water (162° K) at the same absolute temperature.

Since the amount of energy radiated by a black body at long wavelengths is approximately proportional to the first power of its temperature, the energy received from the ground would be roughly 70% greater than that from water, more than sufficient to enable a passive radar to discriminate between the two.

Target Detectability

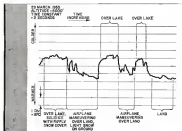
Passive radar's ability to discriminate between different objects under various circumstances, upon a number of factors including:

- Apparent temperature differential between the objects.
- Crossing angle between antenna beam and the objects.
- Antenna polarization.
- Antenna beam width.
- Receiver's minimum detectable signal level, and a function of several other factors.

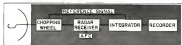
The critical determinant can which the receiver designer has no control is the apparent temperature differential between objects under surveillance. For some representative measurements made during an early AFRCG investigation, showing the apparent temperature difference between objects listed:

- 10K: building and sky beside the building.
- 6K: snow-covered ground and dry ground.
- 4K: dry ground and wet ground.
- 12K: wet ground and top of automobile.

AFRCG investigations showed that the apparent temperature of smooth surfaces, like water, depends upon the angle from which it is viewed, i.e. the



APPEARANT TEMPERATURE difference between land and water, which enables pulse radar to discriminate between the two, is shown as a result of their relative latency.



PASSIVE RADAR resembles ordinary but uses conventional radar receiver techniques. Black display shows experimental system used in early tests. Further experiment would use outside ray tube as a PPI type display instead of recorder shown.



EARLY PASSIVE radar mapping and guidance tests were conducted at 5 mi. wavelengths by Air Force Cambridge Research Center in Navy ship. White parabolic dish in open window is for mapping, while slotted antenna port below was used for guidance.

vertical angle of the power radar antenna beam. Even more significant, the apparent temperature of some objects is seen by passive radar depends upon whether horizontal or vertical antenna polarization is used.

The polarization effect is most pronounced at small grazing angles, disappears when the antenna is looking directly down at the object. For example, smooth water at an absolute temperature of 291K has an apparent temperature of about 160K when viewed from directly overhead, equal to the antenna polarization. At a grazing angle of 30 degrees, with vertical polarization, apparent temperature rises to 240K, or 60K above. But if antenna uses horizontal polarization, apparent temperature remains at about 160K.

Conversely, on the other hand, increases the same apparent temperature regardless of antenna viewing angle at polarization. Asphalt black-top exhibits the same apparent temperature regardless of viewing angle when vertical polarization is used, but with horizontal polarization apparent temperature drops as antenna viewing angle changes from vertical to small grazing angles.

The foregoing suggests that the polarization characteristics of different objects could enable a passive radar to discriminate between them even when the two have nearly identical apparent temperatures when viewed from directly overhead.

Declassified Report

As pointed out in a recently declassified AFRC report by Dr. E. A. Lowe, A. J. Vaccaro and Gary, "It is difficult to distinguish an asphalt surface from surrounding areas vegetation, the line of sight (of the antenna) should make a sufficiently oblique angle with the asphalt and the polarization should be horizontal. The asphalt would thus appear 'colder' than the green vegetation which appears 'warmer' on both polarizations."

"Consequently, vertical polarization would be better for detecting flat asphalt objects (and such as vehicles) as the canopy, since for practical purposes the metal is a very poor emitter of both polarizations while the asphalt induces vertical polarizations more strongly. For locating bodies of water in a wooded terrain, horizontal polarizations and an angle of incidence within 60° of the perpendicular could be used," the report says.

The microwave radiation, or "signal" which must be detected by a passive radar receiver, is a form of noise with the same random fluctuating amplitude as the thermal noise generated within the receiver itself. The problem of distinguishing the signal from internal receiver noise is made more difficult by



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the fact that the signal level is consistently low, usually of an order of a microvolt at a maximum or less.

Signal detection is accomplished by inserting a square wave chopping wheel (or fan-like oscillator) between the antenna and receiver to alternately block and pass the signal from the antenna to the receiver. (AFRCRC's experimenters have used a chopping wheel rotating at 10 cps, as a fan-like oscillator operating at 1,500 cps, to modulate the incoming radiation.)

Using conventional radio antennas (inductors) techniques, the AFRCRC receiver uses a balanced crystal stage fed by a reflex-lyttron radio oscillator

to produce a 10 mc or 60 mc. auto-modulated frequency signal which is amplified, then detected to produce an audio frequency signal at the chopper modulation frequency.

This signal is amplified in a local pass amplifier, then demodulated using a 30 or 1,000 cps reference signal as disclosed with the chopper modulation. The resultant signal is then integrated in a low pass filter network.

In AFRCRC tests, the d.c. output was used to operate the pen of a simple strip recorder to make an apparent comparison possible of the signals received. In a better equipment, the signal could be used to actuate meters

like a PPI type of cathode ray display.

If radiation is to be immediately detectable, its magnitude must at least equal the peak-to-peak fluctuations in receiver noise. Care points out. The theoretical maximum for a signal receiver with a noise figure and an IF bandwidth of 12 mc or less apparent black body background differential of one degree, which an integration time of four seconds is used. In experiments used an AFRCRC test, which had 15 lb. noise figure and an IF bandwidth of 12 mc or less apparent black body background differential of two to three degrees could be detected with four second integration times. Care says (The IF bandwidth of the receiver was twice the IF bandwidth, at 24 mc, v. 12 mc on either side of the local oscillator frequency.)

Because the measured detectable signal level is inversely proportional to the square root of integration time, it is possible to trade off and use shorter response times where low sensitivity can be tolerated. For example, a pressure meter such as one of AFRCRC's air-borne tests, operating at 8 cps, was able to discriminate between land, small water area maneuvers and slightly covered parking lots using a time constant of only 0.5 second.

Wideband Amplifiers

However, it has been the more detectable of individual, low-noise microwave amplifiers, such as the mixing wave tube, that has opened the possibility of using passive tubes as high-speed aerial commutators where even lower time constants are needed. Passive tubes are even detectable signal level more directly with receiver noise and inversely with the square root of protection bandwidth, as well as integration time.

Some of the newer TW tubes have bandwidths of several thousand megacycles, compared to the 24 mc. or less IF bandwidth in experimental AFRCRC receivers. Other tubes, with less bandwidth, but a much higher, or around 5.7 db, compared to the 15 db in AFRCRC receivers.

Although TW tube designs have not yet achieved tubes with both a nearly wide bandwidth and the low noise figures, there appears to be considerable hope for the future. Even with existing TW tubes, appreciable reduction in time constant is possible. The new Moss amplifiers with critically low noise, are another possibility.

Passive radio receivers, like that of active radio, depend upon antenna bandwidth, which is a function of operating frequency and antenna diameter. If an object does not reflect all a percent radio beam, an apparent temperature is seen by the antenna in



Airborne Teleprinter

Airborne radio teleprinter, called Aero Modeler includes both an transmitter and receiver operating in 100-110 kc band, weighs 15 lb. including antenna. Receiver is compressed, has 170 cycle per second of 6 db down points and a single stage of 100 db. leading prior to signal spectrum of crystal discriminator. Model 15 Teleprinter capable of operating at 50 or 100 words/min. is incorporated. Unit operates from 18 v.d.c. and 115 v.a.c., 400 cycle power. Manufacturer: Woburn Corp., 121 Eighth Ave., New York 18, N. Y.

proportionally reduced to the percent age of the beam that it does fill.

Generally speaking the design of a mapping radio uses the highest possible resolution but must balance this against the greatest atmospheric absorption that occurs at the higher frequencies. This is particularly true of passive radio which must utilize a signal that is currently less loud even without any atmospheric absorption.

The actively driven response time of passive radio is another factor which may set the upper limit on resolution, since a smaller beam must scan faster to cover a given area.

AFRCRC has carried out passive radio tests at three different operating wavelengths, 3 mm., 1.25 cm., and 1 cm., while active radiometer similar tests at 1.5 cm. range for detection in atmospheric absorption. Care reports that there was no significant difference in performance of any wavelength.

Airborne Tests

AFRCRC's airborne tests were conducted using a variety of vehicles, including a Navy biplane, a C-47 and an S-55 helicopter. The results of these tests were encouraging despite the fact that experimental and research type equipment was used.

For example, passive radio mapping was accomplished by means of a recording strip moving across a vertical chart paper. When a signal indicating land was received, a voltage was applied to the stylus, heating it and causing it



Valve Talk

FOR WM. R. WHITTAKER CO., LTD.

BY MARVIN MILLER

A Whittaker parking lot has disappeared and in its place has grown an intricate system of lines, links, valves and instrumentation—an extensive new test laboratory to assure that the company will meet and best existing demands.

John Fitzpatrick, chief project engineer, explains that the valve business faces more and more critical criteria—higher flows, greater pressures, better temperatures—it faces mandatory reliability far above that required in the past.

Aircraft are more and more susceptible to component malfunctions. Where a failure used to be little more than a nuisance, today it can mean the loss of an airplane—and its crew.

The reliability requirements for mobile units are still more exacting than those for aircraft, and Whittaker is giving even deeper study to the mobile field.

Today it is necessary to push engineering and development even faster over today's into tomorrow.

"This means testing of the most advanced valves, a most factor in the modern valve industry. In the old days you used to make test runs and if it worked, you produced it. Now today qualification tests and reliability programs insure the most advanced laboratories. Test work can run as high as 10 to 16 months or more, over any given available time within the span of operational runs."

Now as a result of this procedure and a few production runs now and then. The control valve of superpower and hydrocarbon systems demands a great many more tests to be tested to secure the reliability of all units.

Whittaker's new test facilities have been constructed on a one of about a quarter million dollars but testing fluid, hydraulic and pneumatic systems and components. Among the facilities the pneumatic testing are two compression chambers 100 pounds per square inch (125 p.s.i.), plus two 100 pounds per square inch (100 p.s.i.) testing capacity units to 1250 p.s.i., and three a enough margin capacity to permit blowdown testing up to 1900 pounds per square inch and down to 30 p.s.i. or below. There are 18 individual test systems in the system for hot and cold use.

Now featured in these new facilities is the equipment with which to test back pressure pressure valves and regulators in 6000 p.s.i., while a bulky system of tanks and lines is available for the testing of critical mobile valves and applying liquid oxygen, gaseous oxygen, hydrogen peroxide, ammonia, etc.

Now featured in these new facilities is the equipment with which to test back pressure pressure valves and regulators in 6000 p.s.i., while a bulky system of tanks and lines is available for the testing of critical mobile valves and applying liquid oxygen, gaseous oxygen, hydrogen peroxide, ammonia, etc.

Exhausted, increased, increased most certainly, this was, nevertheless, no use to terminate the test.

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to burn during the wet coating to expose a black undercoater. For this reason the quality of passive radar maps made by AFMRC is not sensitive of the quality that could be obtained from a passive radar system designed for tactical use.

Here are a few of the observations made during AFMRC's airborne tests:

- **Steps underway** in Burma harbor could be detected by passive radar because their surface appeared warmer than the surrounding water.
- **Land-water boundaries** were clearly visible with a 1.25 cm system at 6,000 feet altitude, despite a heavy fog resulting from the ground which was so dense that the airplane's wing tips were not visible.
- **Automatic guidance systems** for missiles as search using land-water boundaries using passive radar techniques appear possible, based on limited AFMRC tests.

Hybrid Systems

The tactical advantages of using a non-detecting, nonactive, surveillance or mapping system to avoid enemy detection, which has focused to attack military interest on infrared, appears better to create radar interest in passive radar.

It is true that passive radar is more susceptible to enemy jamming than

active radar or infrared. Yet it poses some security over active radar from the fact that the enemy does not know what operating frequency is being used. Without too much concern to security or complexity, it should be possible to design hybrid systems, using passive radar in combination with active radar as infrared, to give greater tactical flexibility than is available from the use of any one of the techniques.

TYPE TTYE FILTER CENTER ELEMENT

• **Highs in Shopping Month**—Hedden Aircraft, according to several of its non-military aviation divisions, is looking at small companies in the components and test equipment fields with the view to possible acquisition.

• **Russian Satellite Lags**—USSR technical publications indicate that the Russians are becoming heavily interested in trans-harbor communication but they appear to lag several years behind U.S. in the field.

• **New Insulated Wire**—"Fixed-Film Wire" is a new wire with Teflon film insulation measuring only 0.002 in. thick. Insulation resistivity has "100% greater dielectric strength and surge resistance than any com-

parable insulation," according to Atlas Consolidated Industries, Union, N. J. Insulation is said to be stable when temperature cycled between -200° and 1000° and can withstand 6,000 volts.

• **New RETMA Name-Radio**—Electronic Telecommunications Manufacturers Assn. will adopt new name, Electronic Industries Assn., if majority of members approve in upcoming ballot.

• **Weather Radar Short Course**—Microelectronic Institute of Technology will conduct a short course, Aug. 12 through 23, on weather radar and its applications as a meteorological tool for forecasting. Course is designed for both radar engineers and meteorologists to acquaint each with the other's job and achievements. Tuition is \$216. Program will be under supervision of MIT's Dept. of Meteorology.

• **Radar For Australia**—Two large Australian companies, at Sydney and Melbourne, will be equipped with Databank C.R. 21 surveillance radar.

NEW AVIONIC PRODUCTS

Components & Devices

• **Thyristor capacitor**, in high macro-lateral values for low voltage d.c. applications, are rated by maximum of 1,000 hours operation at 125°C. Units are in three rectangular case sizes, all with lead dimensions at 1.130 x 0.75 in. in



lengths of 11, 21, and 24 in. Typical rated for standard use at 10 volts, 1,000 microfarads, polar construction, standard full Levele units are rated at 50 x General Electric Co., Capacitor Dept., Hudson Falls, N. Y.

• **Transistorized d.c. pulse mixer**, Type MY2A, now available in micro-miniature size with built-in pulse generator which greatly reduces amplitude of required input signal. New relay control in three models "M"-a latching type which remains in last position when input signal is removed, "B"-a non-latching type

which, and "C"—with open-circuit coil feature. Bulletin 7774-2 gives application data. Radio-Columbia Co., Rockford, Ill.

• **400-Cycle frequency meter**, Model 205, for aircraft instrument panels, provides accuracy of 0.5% over frequency range of 50 to 700. Meter is



designed for 115 v. operation and can be calibrated from 50 to 400 cps. Consolidated Avionics Corp., Stamford, Conn.

• **Precision sine wave generator**, 1001, dc, is available with accuracy of better than 0.1% for rejection at



frequencies of 400 to 1,600 cps. Application data is available from Reeves Instrument Corp., 287 East 51st St., New York 25, N. Y.

• **Coaxial type voltage regulator**, with current ratings up to 4 amp, are now available for military applications as V61 and V71 envelopes in voltage ranges below 3,500 v. Application data is available from The Wellesley Instrument Co., Corporation Div., 1535 Hough Ave., Cleveland 3, Ohio.

• **Masterless klystron synchronizer**, model, is rated 100 times (1 in. dia.), is



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- High Temperature Operation — to 150 deg C
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available in 8,000 and 12,000 cps models, single or three-phase, 25 or 115 vdc. Motors are designed to meet MIL-5000 environmental requirements, are available in range of torque ratings. Lathes: Mfg. Co., 7132 Varco Ave., North Hollywood, Calif.

Laboratory Equipment

• Sweep-frequency VSWR measuring system, Model 160, covers frequency of 5-4 to 12 kHz, provides sweep rate of 0.02, 0.1, 1.0 and 3.6 cps. System com-



plete includes 5-in. oscilloscope, with scale reading directly in VSWR. Presentation is duplicated on 4-inch meter and on optional recorder with charts scaled in VSWR. Caltech Technical Institute, 1419 Old Country Rd., Redwood, Calif.

• Stand signal generator, Model SG-113, covers frequency range of 1.8 to 4 kHz, in single band. Output is continuously variable between 0.2 and 200,000 milliwatts. Signal generator can be pulse or frequency modulated. Pulse can be internally or externally



triggered. Output includes two separate synchronizing signals. Delay circuit per each RF output can be adjusted on adjustable interval after undelayed synchronizing signal. Transducer, Inc., 180 Center St., Manchester, N. H.

Instrumentation

• Multichannel flow recording system, Series 1000, provides 300 ch. band-width, choice of six speeds up to 60 in./sec. selectable from single switch, and modular construction. System also



handle real time up to 14 in./sec. up to 19 in./sec. as you desired and can accommodate 1, 4 or 1 in. wide tapes. American Electronics, Inc., Records Div., 615 W. Washington Blvd., Los Angeles 35, Calif.

• Axial accelerometers, with high resolution, piezoelectric output, are available in ranges from $\pm 1G$ to $\pm 40G$ with undamped natural frequency ranges from 7.5 to 34 cps. Units are hermetically sealed and oil damped, designed to withstand rugged environments and to provide low output drift. 401C-AC measurement and (flexible) G. M. Giannini & Co., Pasadena, Calif.

EQUIPMENT



SECOND ORDER aided tracking allows one operator controlling theodolite with small control (left) defers to track more accurately in vertical, horizontal planes. Stick movement produces correction not velocity. Ring sight (right) is useful because of narrow vision field.

Optical Tracking Data Speeded By Human-Engineered Theodolite

VAN NERS, Calif.-Prototype optical tracking theodolite designed to eliminate the data reduction bottleneck by offering ease on true digital readout has completed acceptance tests at Naval Air Missile Test Center, Point Mugu, Calif.

In designing system an accurate demand exists for such equipment because manual reduction of tracking data from a few minutes run time requires days of work up to two months. Range schedules and government contract in quarters often demand one or more months not longer per month which means that trade and investment can better the losses of the previous firing have been alleviated.

Human-Engineered

The new device, called RADOTT (Recording Augmented Data Optical Tracking Theodolite), utilizes extensive use of human engineering principles to reduce operator stress. These stress have delayed designers of earlier optical tracking to rely on photographic readouts on film strip tubes of the target that allow data reduction errors to correct angular errors in measuring distance of the target from center of the line of sight. RADOTT was designed by the H. A. Wagon Co. here.

The prototype was designed and built under a Navy study contract administered by NANTIC Point Mugu.

NERS felt the principle should be evolved in operation and project efforts as they are attached with the basic theodolite. It has not been tested with the data reduction system.

Automatic data reduction requires a network of units transmitting bearing information to a control computer for integration of a reading 60 at once to record results. This can be projected and accurately in similar form by a digital computer. True log in storage-out digital data is a half-second or less.

For some projects, initial calculations are best. It is less accurate but one of its advantages is the ease with which a direct graphic presentation can be made. Another is an on-line readout for those cases where it may be desirable to modify the flight program during the course in which other measurements may be related to the tracking net.

The theodolite data reduction system could not be tested in the present track because of prototype theodolite has been built. Since the test was of the theodolite alone, angle readouts on the prototype were recorded by photo guiding manual control.

One objection to the RADOTT has been that it makes the operator's job tedious as unaided effort in the accuracy of the measurement. At that stage the area power scope and the accuracy of the instrument desired.

that the procedure be held on a specific point such as a wing root or engine tip. Without photo verification there is no way of being certain that all operators hold on the postulated point.

Another advantage of having the unit is that photos can be checked for data on absolute angular difference. Failure of structure, etc. To counter these objections, a camera installation for RADOTT is now being studied which would provide a check on the only manually processed data and would make available other data than track, velocity and acceleration.

The theodolite was first prepared to Mags by Wagon in 1957. Prototype development began in 1954.

Increasing Complexity

The RADOTT represents the second phase in the increasing sophistication and complexity of optical tracking from the complex, manual, two-operator theodolite, manual theodolite. The first reference was first order theodolite which is which some errors using the theodolite at a given angular velocity for a given displacement of the control and which provides the operator with a set that swings with the instrument rather than being kept in view, would the instrument as it swings. All of the first order aided tracking device action two operators and are inherently inaccurate to require photographic readouts and corrections during the manual data reduction.

The RADOTT uses aerial color aided tracking in which the rotation of the line of sight corresponds to the case of the control deflection, to an

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tugal of deflectors and a second integral of deflection with respect to time so that a constant deflection causes a proportional constant angular acceleration and a control constant position produces a constant angular velocity. Wagon engineers consider that an integral velocity is a constant target angular velocity is most rare. The only large test facility which supports a positive response on the part of the RADOT operator are transitions in acceleration. A constant velocity or constant acceleration target is no more difficult to hold than a target at rest.

A critical approach to the human operator's capacities has also yielded worthwhile advantages. This stems from three principles:

- A certain amount of locking error is a necessary evil

* Some part of operator error is predictable and can be derived from control motion and added to the base instrument response to produce a more accurate result.

* When error easily predictable motion appears in the tracking task, the operator's trust in mechanism and efficiency falls off. In responding to high frequency or rapid onset variations, the operator is at his worst if he believes in a thinking brain.

The human operator's tracking error is limited to high frequency, low amplitude variations by giving the instrument a dynamic time that is substantially

slower than that of the operator and, by placing the operator's physical task so that physical response time is minimized relative to visual and mental reaction time. The effect of this is to allow him to act before he thinks, thereby cutting his response time to about 170 milliseconds.

Alerts Operator

A considerable tracking error remains to keep the operator alert. Much of this is predicted and compensated by a tracking error computer to reduce angular error as the readout to a level approaching human powers of visual resolution. At long range, visual resolution is actually the limiting factor in RADGITT accuracy. At short range, the target fills so much of the visual field that holding the crosshair on a patch defined sighting point on the target lock becomes more sensitive.

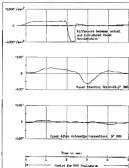
As a result, knee extension, in terms of feet and inches is relatively independent of range, but is ordinarily back at midrange ranges of 10 000–20 000 ft. The slight deviation not eliminated by the tracking error computer corresponds to 'noise' in the human system.

Severed order and plans an important part in cutting human response time by linking control deflections with movement accelerations rather than speeds, it greatly reduces the susceptibility of control and hand movements needed to come with rapid changes of force.

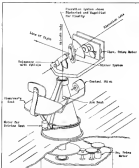
costs are not good. RABOTT designed the advantages of this by using a well-known type control stick, rather than the lever controls which make the standard trucking driver. Since the use of control sticks requires only one hand, a single operator can act as if in total, in both forward and reverse. Because of the small mass and flexibility of the stick and Sages, the second control has the advantage of the control in this body response. Designers of the RABOTT have been able to keep the same and continue pressure on the stick, low so as not to inhibit the function response.

birds actively select the three-dimensional structure of the environment in which they forage. In many cases, birds select the height of the foraging site, the size of the foraging area, and the type of vegetation. For example, many birds select the height of the foraging site to avoid predators. In some cases, birds select the size of the foraging area to maximize the amount of food they can obtain. In other cases, birds select the type of vegetation to maximize the amount of food they can obtain. For example, many birds select the height of the foraging site to avoid predators. In some cases, birds select the size of the foraging area to maximize the amount of food they can obtain. In other cases, birds select the type of vegetation to maximize the amount of food they can obtain.

Open loop programming of the anticipated trucking task eliminates one more predictable driver's error. The operator's responsibility is then limited to



TOP CHART (left) shows difference between acceleration programmed into tracker and actual acceleration. NB&S chart shows engine noise, and the lower the amount of noise measured after conversion, the closer actual acceleration is to programmed acceleration. The chart below shows engine noise.



20. H. H. Gossard and J. H. Gossard, *High-Speed Transistors*, Wiley, New York, 1966.

Flight Test Engineering – the dynamic field for engineers

A statement by R. L. Thorne, Chief Flight Test Engineer, California Division, Lockheed Aircraft Corporation

The technology of flight and engineering requires an engineer of special ability and attitude.

There are always a large number of aircraft demanding the mastery of professional flight test engineers in a company as diversified as Lockheed. At present there are 30 aircraft—12 different models—on hand for extensive flight test operations. In addition, the flight program staff at Langley and other significant centers will soon swell our schedule.

A major flight test effort such as this calls for an engineer who is flexible, able to cope with changing assignments that vary widely in complexity and approach. He must be able to improvise on his

Architect is showing off Lockheed's new approach to PCB test engineering, an experimental center. It is scheduled for November 2000. www.lockheed.com

test, the deck board must be cut-off place in an dynamic field in flight test. Moreover, the most positive ability is flexibility. He is so spontaneous in a single phase of engineering. His suggestions cover the entire aircraft. And in flight testing begins in preliminary design under new philosophy of engineering, he participates actively in design and development of all Lockheed aircraft from their stage through completed testing. Permission to say in flight test background at Lockheed helps specially an engineer for virtually any key engineering position in the company.

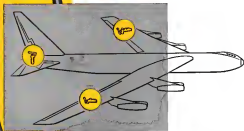
Our expansion program has created new positions for Flight Test Engineers, Flight Test Analysis and Instrumentation Engineers with those titles. Many of the positions are on a senior level and we particularly interest engineers with flight test experience. I have asked E. W. Des Lauriers, manager of our Personnel Staff to give you further details. I will list them below.

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and be sure to specify LINEAR "O" Rings.



Mobile Tracker Delivered to ARDC

Telescope photogalvanometer, described by manufacturers as first completely mobile optical tracking system, is being tested by the Air Research and Development Command at Air Force Armament Center at Eglin AFB Fla. System built by Perkin-Elmer Corp., Norwalk, Conn., consists of a 9 ft. long 100 in. steel length supporting telescope equipped with a 70 mm. motion picture camera, which, with two sighting telescopes, controls and equipment, is mounted on a two wheel modified 90 mm. gun turret. Primary telescope lenses can be changed to accommodate 200 or 300 in. focal lengths. It can be operated manually or by operator.

following deviations from the planned target flight. Autopilot of the target's track does not have to be especially accurate for this technique to be profitable. This is especially true during the boost phase of missile flight when high, rapid coast acceleration would make tracking error undetectable. Fully automatic tracking of only the accuracy permits reduces the magnitude of manual correction required of the operator. The boost period is a critical time during a tracking operation in failure to hold the target during rapid accelerations may convince the operator and run his effectiveness for the remainder of the run. The open loop program can be triggered by a firing pulse from the launcher so the whole test run can be supervised by the synchronization pulse usually transmitted by range communication system.

Tracking Tolerance

For a smoothly accelerating target, RADGITT can track within 0.1 angular mil. The RMS accuracy is about 0.5 mil.

Lateral error due to unpredictable constant rate of acceleration is 1 ft./G/sec. At a range of 50 000 ft., tracking error due to limits of visual resolution is about foot.

The new trailer has a 360 deg.

tracking field in azimuth and an elevation field from -1 degree to +70 degrees. Maximum angular tracking speed is 10 deg./sec. around both axes, though the 12 000 rpm servo can rotate its capable of engaging the shoulder at twice that rate. Maximum angular acceleration for the servo driven main shafts is 15 deg./sec./sec. The system is capable of angular accelerations of 300/deg./sec./sec. within its limited range. Shaft systems in the drive road will make one revolution of the slow speed main shafts into 175 000 parts.

The narrow 7 deg. field of view of the RADGITT scope makes the problem of target acquisition. It is made possible by the operator to use the scope for this because of the low probability of placing a distant or fast moving target within such a small area. With second order auto tracking, preliminary tracking in an area of four to eight degrees visual references will result in the instrument according to track angle velocities of which the operator is unaware because of the small shift, deflection required to produce them. If the angular swing has a vertical component, the instrument will swing into its stage and declutch. If be good for time, the scope should actually swing across the target, the operator would probably not see it because of the speed

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A4D Goes to Sea Duty

Boeing A4D-1 Skyhawks of VA-14, a special weapons squadron, face an onerous long-term Florida. Squadrons will be first A4D squadron to join fleet at sea.

with which it would cross his field of vision.

One target acquisition device which was tried was a mixed scope of equal power that could be switched in the optical system. This failed to work out because the combined lens aberrations ruined the quality of the picture. The solution finally suggested by the Navy project office was an external reticulated ring light which deflects the natural light into colored Newtonian rings having an angular diameter controlled by the position of the sight controls and which is independent of the distance from sight to eye. Since the operator has an unobstructed field of vision, it is quite easy for him to place the sight upon the target before anything in the display.

Wages expected to be able to market the new fuselage in quantities of 50 for less than \$100,000 each.

Red Bird Target Maker Goes Out of Business

East Coast Aeromastics, Yellow, N. Y., has been liquidated by its parent company, Ramco Steel. The firm had employed 300-400 persons.

With only 70,000 sq. ft. floor space East Coast would fill up its shop with only four jobs and if there was a dollar in one of those jobs it would begin to lose money," a Ramco spokesman said. "It was a matter of either expanding to 350,000 sq. ft. or liquidating." In view of the cutbacks in military subcontracting and the loss of private contractors to do the work, he is taking back work into their own shops, he also decided that it would be wiser to liquidate.

East Coast's Red Bird low target has been sold to Liberty Aircraft,

Farmingdale, N. Y., a subsidiary of the First Levis Corp. and its facilities cap business has been sold to Federal Manufacturing and Engineering Co., Garden City, N. Y.

The Redbird low target was one of East Coast's most successful projects. It was built for USMC and a few more for the French and other NATO countries. A replacement Redbird is now being evaluated at Eglin AFB, Fla.

Facility Planned for Testing Suppressor

Sound suppressor/thermal reactor for Boeing 707 will be tested at a new facility at Boeing's Renton, Wash., transport Division plant. Work on the \$300,000 facility will begin immediately after contract signing and should be complete sometime this fall.

It will consist of two general run-up silencers. Compressor and turbine noise



Thrust Reverser Seal

This is a prototype of a bellows and seals for Boeing Airplane Company's 707 jet engine thrust reverser. Built at 13 in. in diameter, 11 in. wide and seal and with a total deflection of 140 in. Seal will operate at temperatures up to 1,150°F. It weighs 3 lb. 5 oz. Manufacturer: Skinner Seal Company, 3000 Santa Fe Street, Santa Ana, Calif.



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level should be reduced to "first emergency inside a five-minute car." Salvor tubes are 45 ft. long, 12 ft. in diameter and are mounted upon an 85-ft. x 850-ft. concrete slab. Test engine controls and instrumentation will be located in a 40 ft. trailer between the two units.

Being originally planned to build the test stands at Mass. Lake Flight Test Center, but recent reduction of the original fundraising efforts appears good enough to locate the units at the Keweenaw plant.

Flight testing of the short recovery stand suspension is scheduled to begin this summer.



SECTIONAL view of new Jack & Heintz six-cyl. motor shows cooling air flow.

Flexible Range of Motors Developed

Wide line of "flexible standard" six-cylinder motors for aircraft which will deliver thrust in half is under development at Jack & Heintz, Inc.

Nucleus of the line will be made up of over 40 motors ranging in size from 4 to 25 hp. in SAE classes IV, V and VI.

Initial production is expected to start in August.

Options will be available in three types: continuous duty—open vented, continuous duty—totally enclosed, fan cooled; intermittent duty—totally enclosed, intermittent duty—totally enclosed, with fan.

Lineations are being designed for 8,000 and 12,000 rpm synchronous speeds with provision for extension to other speeds. While design of the line of motors follows SAE standards quite closely, J&H says it is making significant reductions in weight and size of the units.

Company cites three examples of continuous duty, open vented motors: An SAE motor weighing 7.72 lb. will weigh 4.80 lb. in the J&H version; a 9.56 lb. model drops to 7.0 lb. and a 25.5 lb. motor comes down to 17.8 lb. if the casing is aluminum or 16.95 lb. if magnesium.



CONVAIR R3Y-2 Endured tests on the bottom of the bay, three turbine salvaged, with a 5x14 ft. hole in hull.

Small Turbines Salvage R3Y-2 In Bay

Salvage of Convair's 30-ton R3Y-2 T-28 twin-engine test-bed—which had a 9 x 14 ft. hole torn in its hull during a recent emergency landing brought in by a rescue jettison on its parachute engine—was accomplished by pumping out most of the water in the hull with air supplied by two small gas turbines.

The plane had come to rest on a sand bottom three months submerged in one foot of water in San Francisco Bay. To salvage it, a crew from the Alameda Naval Air Station first sealed the hull, except for the gaping hole in the bow.

The plane was hoisted by air bags to keep it afloat in case of failure of the

plane was lightened by draining its fuel and removing the tailprop engines and propellers.

Then air supplied by the two GTC 45/44 Aerochem gas turbines through a concrete shaped duct was piped into the hull. In a few hours, the plane was broken loose from the bottom and moved until only 18 inches of water remained in the hull.

Over gas turbines was then shut down and the bag flying boat removed afloat as air supplied from the two gas turbines. As a safety measure, tops of the plane were hoisted by air bags to keep it afloat in case of failure of the

air supply or other contingencies.

The 14-mile tug back to the Naval Air Station was made, as was a hull boom via tow by Navy salvage ship. During the tow the boat carrying the gas turbines served as escort and the net pressure was maintained.

Communications between the damaged flying boat and the tow ship were maintained with portable electronic megaphones. Airplane was beached but 65 hours after its emergency landing.

The flying boat is based at Alameda Naval Air Station, where it will undergo repairs. None of its crew was injured seriously in the landing.



AFTER 90 hrs airplane was used, wings were hoisted up with inflated air bags in case of loss of compressor failure.



Flight deck crew prepare C-27, a Grumman Tracker built by de Havilland of Canada, for hoisting from stern catapult of new Canadian carrier, Bonaventure.

Bonaventure Flight Trials Begin



Double jet fighter is catapulted (above) during flight trials started on Bonaventure at United Kingdom waters. Amphib deck carrier (below) was built by British. Two Bonavents and two Trackers were brought aboard for the cruise. They were flown over the coast of Canada for the operation.



4 IMMEDIATE OPENINGS FOR ENGINEERS

Senior Structures Loads Engineer. To determine air and ground loads, airframe temperatures, cruise stability of aircraft, and repeated loading criteria. Requires engineering, math or physics degree, with 3 or more years experience.

Package Designer for Electronic Equipment. Mechanical or electrical engineer to design the package and structure of avionics systems, antennas and other high-reliability electronic equipment. Requires engineering degree or equivalent. Related experience desirable.

Instrumentation Engineer. For missile test program. To provide technical direction for operation, maintenance and development of flight test telemetering equipment. Requires engineering degree plus 2 or more years related experience.

Inertial Guidance Systems Engineer. For key role in developing guidance system flight test techniques. B.S. in Electrical Engineering or Physics, experience with gyros and accelerometers or digital computers.

Be sure for a personal interview, as for a permanent position on these or other current openings, return coupon to:

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The development engineer who exercised his option

When it comes to end products, Bill Crowder never finishes what he starts.

While Bill's colleagues were busying to complete a missile that he initiated, Bill helped launch eight other major projects and saw minor studies. A restless wanderer, that's his pride in the Chrysler Vought's Development Section.

Bill's department analyzes requirements for new weapons. Specs come from the military, or from Vought's own Advanced Development Planning Group. They outline an approaching road or direction in our defense structure. It's up to Bill and from time to time they project trajectories to produce missiles that will fill the vacancy.

From Development's desks and bill systems come new configurations. Specs are radically different, often, those to conventional. The best are projected, electronically, into the unknown; they must dominate.

For example, Bill can forecast a proposed missile's flight behavior by studying stage forces and columns of IBM tabulations. Electronically, he can observe various performance details such as post effects on a recoverable missile's landing approach.

Tests like those reflect from Bill's own offerings and those of others the configuration that best

solves the problem. Once this pattern is "ball-parked" for appropriate actual use, it's ready for detail design . . . likely to become a full-scale project.

Time now for Bill to exercise an option all Vought development engineers enjoy. He may follow the project he's begun the full route to completion. Or he may remain in Development and accept a new assignment.

To himself, Bill justifies his choice something like this: "Changing assignments gives me a chance to shift gears . . . to change my approach . . . to broaden myself."

To proper engineers, anxious for him to follow a promising project out of Development, Bill's "no thank you" is practically a matter of course.

They know he's already cleared his desk for the next new challenge.

In Chrysler Vought the Development Engineer explores a unique variety of configurations and operational environments. He may limit his analysis of heat- and sub-heat weapons to preliminary design studies, or he may accompany his project through its complete development cycle.

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BUSINESS FLYING



NORTH AMERICAN AIRBUSHER (top picture) three-engine transport, which should be flying early next year, is shown in model form. This GE J85s are tested in long aerodinamic shape the swept wings, extended tailplanes will carry inherent noise well behind cabin area.

Lockheed, North American Stir Jet Race

Los Angeles-Lockheed and North American have taken a large lead over other military contractors in developing a new light jet with transport and crew readiness features for US Air Force.

Configuration of the new airplane is shown in exclusive Aviation Week photos on these pages. Taken during recent first public viewing of films of the Lockheed and North American entries. Like the other entries in USAF's

development program for these classes of aircraft, the planes are being designed to meet Civil Aeronautics Administration requirements for use them for use as high speed business transports (AW Feb 13, 1964, p. 32).

This report features models of the two West Coast designs. Lockheed's new CL-329 transport under development will be the first to fly—the company has set a mid-September target for its

initial flight of its prototype—and North American has started casting metal on its smaller two-seat Sabreliner. American West's second prototype is scheduled to fly in next February and first flight will be in March, estimated sources say.

Both airplanes are planned around the new General Electric J85, weighing 350 lb dry and delivering approximately 2,500 hp. Three-

Design Details

•**Lockheed CL-329** is a swept low-wing 10-passenger configuration, with wings clean because the four engines are mounted in pods in side pylon on the rear fuselage, the rearward pod being separated from the fuselage by a narrow notch one foot diameter. The engine location is designed to provide a more even noise level in the cabin and as a safety factor, the turbine wheels are located well behind the cabin pressure bulkhead. In event of a wingtip load, wing engines would be protected by the belt and low cut wing.

Two-engine version of the Lockheed CL-329 powered by Bristol Orpheus turbojets in the 1,500-1,600 hp thrust class each will take to the air first, American West's second. The company planned the CL-329 around both four J85s and a pair of Orpheus jets, according to informed sources.

Strikeline, of the "off-flight" type, is powered approximately one-quarter of the way up the fuselage and has steep climb to the wing.

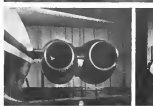
Cabin is air-conditioned and pressurized to maintain 8,000 ft altitude when the CL-329 is flying at 45,000 ft. The airplane has ample accommodations for baggage and a galley.



BADLY NAVIGATION: "Black lines" will go on Sabreliner's long nose to ease maneuverability.



CLEAN SWEEP WING of Lockheed CL-329 (model air) will yield a possible 100-mph climb of 100 ft per sec, which also protects engines in event of wingtip loading.



POO-HOUSTING (left) of twin J85s on side of Lockheed CL-329 shows converging shock. Prototype will fly in mid-September with single Bristol Orpheus jet on each side. Distance to cabin (right photo) is well clear of nose-mounted jet pods.



type, is powered approximately one-quarter of the way up the fuselage and has steep climb to the wing.

Cabin is air-conditioned and pressurized to maintain 8,000 ft altitude when the CL-329 is flying at 45,000 ft. The airplane has ample accommodations for baggage and a galley.

Geometric 35,000 lb, the transport will cruise at 150-170 mph at 25,000 ft to 45,000 ft and will have a range of 1,500 mi at these altitudes without refueling of medium fuel tanks.

•**North American Sabreliner** seats four plus crew of two although the company has plans for a high-density version carrying more passengers and a cargo model. Designed to meet Civil Air Regulations just Orly, the Sabreliner has its pair of J85s located in the wing roots, with tailplanes extending well aft of the swept wing's trailing edges. A retractable inlet screen extends to protect the engine from foreign object damage whenever the landing gear is down.

Sabreliner has single-point refueling system with opening in the top of the left engine nacelle, easily accessible

from ground level at the wing trailing edge. Radar and navigation "black boxes" are mounted in the nose and are accessible from ground level.

Cabin pressurization like the Lockheed CL-329, provides 8,000 ft altitude while the Sabreliner is at 45,000 ft. In addition there is an emergency oxygen system for each passenger. Wing and stabilizer leading edges incorporate thermal protecting.

Sabreliner cruise speed is planned at Mach .75 at 39,000 ft; maximum speed is expected to be 1,400 ft. Single-engine landing will be 15,000 ft and range 1,700 nautical miles, extended to 1,500 nautical miles using auxiliary external fuel tanks. The swept wing jet will have a maximum ground takeoff roll of 2,100 ft, and will clear a 50-ft obstacle on one engine in 3,200 ft. Gross weight will be 14,350 lb.

Numbers Betters

At last first conference, including Lockheed and North American, has indicated interest in the USAF AMC requirement for the two basic configurations, which was circulated to 15 firms

last August (AW Aug. 27, 1956, p. 36). At the time AMC noted that it was an approximate requirement for 1,000-1,500 of the two jet type and 200-300 of the low jet, procuring the airplanes over a five to seven-year span.

NASA is also interested in a light jet over business transport and under transport for high speed transportation of personnel. In addition to Lockheed and North American, three other firms are known to be interested in the Air Force and/or Navy programs.

•**Fairchild**, with its M455E in the low jet category. Airplane costs in the half-million dollar range, and has been ordered in 100 units from Continental Can and Continental Oil for executive transport use. Initial contract delivery is expected to be made in 1966. Fairchild plans the lightweight M455E around four Fairchild J85s in a four-engine nacelle the same power class as the J85, although it was the prototype with Westinghouse J85s to speed its development cycle should the J85s not be available when the airplane is ready.

•**Borch** has been offering the Monoc Sabreliner swept low-wing NB-700 to



Side-view photograph of supersonic flight geometry in wind tunnel.

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Our future security depends on our ability to build tomorrow's supersonic fleet. Technology must advance beyond the present limits of human understanding. Aircraft must fly at speeds far beyond what we now call supersonic. So this test, North American brings its most experience in supersonic aircraft—gained in the Free World. Advanced concepts are being developed—as revolutionary tomorrow as these North American bombers of today!

The F-100 Super Sabre. In 1953, the first production F-100 exceeded the speed of sound on its first flight. In 1954—two years before any other supersonic airplane became operational—the Air Force had F-100's in wing strength. There is still no Air Force operational supersonic airplane that can match the reliability, strength, and performance of the F-100. No other can match its tactical and combat versatility, or its endurance—demonstrated by recent record-breaking suc-

cessful flights from London to Los Angeles, Los Angeles to New York, and New York to Paris.

The X-20 Test Missile proved out the aerodynamic design and flight control systems of the Nevada intercontinental guided missile. The supersonic Nevada is America's most advanced strategic weapon—and the closest to production.

The X-15 Rocket Plane, now in production, will carry man higher and faster than ever before. It is setting the pattern for the Air Force of tomorrow.

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NORTH AMERICAN HAS BUILT MORE SUPERSONIC AIRCRAFT THAN ALL OTHER COMPANIES COMBINED

Beech Travel Air Can Cruise at 200 mph.

Wichita, Kan.—First detailed official performance and specifications data revealed on the new four-place light twin Beech Model 95 Travel Air show that this cabin plane will have a cruise speed of 200 mph at 7,500 ft on 75% power.

Initial delivery of the new business plane will begin this fall. Construction demonstration test is expected soon following completion of CAA (Civil Aeronautics Administration) certification requirements (AW June 18, p. 40).

Travel Air on June 18 received its type and production certificate from CAA—becoming the first completely new Beech airplane to be certified under CAA's delegation upon authority procedure, under which the manufacturer is responsible for approving all engineering data and testing.

Structural tests were at 115% as much as CAA strength requirements. Flight test phase of the certification program was completed in 68 days. Prototype made its first flight Aug. 6, 1956.

New Beech light twin received its first one-hour test without when it was flown from the factory to Ft. Rucker, Ala., for demonstration to the Army. During the 900-mi. flight, which included maneuvers of descent because of heavy weather, the airplane averaged 200 mph ground speed using 50% power and carrying two people.

Some 150,000 yd. of the top wire between and around both propellers, tail streamer activity, with altitudes ranging from 6,000 ft to over 10,000 ft, between and above cloud. About six



COWL FLAPS replace exhaust passages cooling system on latest version of Travel Air.

Beech Vice President General Manager John P. Galt and Engineering Test Pilot Stan Tait.

During the demonstration at Ft. Rucker, Tait got the Travel Air off the line 1,500 ft. runway before he reached the 150-ft. marker and landed and taxied off the strip before reaching the distance. This was done with only the pilot chock and about 10% fuel.

To demonstrate the airplane's acrobatic ability, Tait flexed it down the runway at about 30 ft. altitude at up to 200 mph, deflected each propeller and rolled the airplane toward the lead engine.

The test pilot outlined that the Travel Air is clean enough so that he could take it over a runway at 200 mph, feather both propellers, pull up and turn 360 deg. and make a normal approach and landing with dead engines at approximately the same spot

where he had feathered both propellers. An observer has commented that wingloading in the new airplane is so effective that at 200 mph cruise speed the loadings would make the cabin in that position in being produced in the air next to the ceiling. Beech is investigating means of reducing this time level to even lower values.

Travel Air is powered by the new 1,000-hp C100 A1A four-cylinder top-mounted engine delivering 188 hp at 2,700 rpm. The C100 weighs 252 lb. including starter and generator and operates on 91/95 aviation fuel. Engine measures 24.05 in. high x 35.37 in. wide x 29.35 in. long. Decca Rotor starter, generator and voltage regulator are standard equipment. Electrical fuel pump drive, vacuum pump drive and constant speed propeller governor drive are optional. Engine's features include self-control, variable-type valves.

Beech 95 Travel Air

PERFORMANCE AND SPECIFICATIONS

Maximum cruise speed @ 7,500 ft.	200 mph @ 7,500 ft.	Maximum baggage capacity, less equipment, fuel	270 lb.
Maximum cruise speed @ 2,500 ft.	210 mph @ 11,000 ft.	Gross weight	4,000 lb.
The speed @ sea level @ 7,500 rpm	228 mph	Empty weight	2,560 lb.
Rate of climb @ sea level, two engines	1,155 ft./min.	Useful load	940 lb.
Rate of climb @ sea level, one engine	150 ft./min.	Wing span	57 ft. 30 in.
Service ceiling @ gross weight, two engines	39,000 ft.	Length	25 ft. 4 in.
Service ceiling @ gross weight, one engine	6,200 ft.	Height	9 ft. 6 in.
Absolute ceiling @ gross weight, two engines	20,000 ft.	Wing area	183 sq. ft.
Absolute ceiling @ gross weight, one engine	6,000 ft.	Wing loading, gross weight	115.5 lb./sq. ft.
Max. speed, power off, 15 deg. flap, gross weight	65 mph	Power loading, gross weight	51.3 lb./sq. ft.
Maximum range @ 154 mph, on 150 gal.	1,490 mi.	Cabin weight	60 lb. 21 in.
Endurance	5.75 hr.	Cabin length	1.8 ft. 6 in.
Taxi-out distance, maximum performance, no wind	1,010 ft.	Max. gross weight	4,000 lb.
Taxi-out distance, no wind, 10 ft. obstacle	1,010 ft.	Max. gross weight	4,000 lb.
Landing distance, maximum performance, no wind	579 ft.	Max. gross weight	4,000 lb.
Landing distance, no wind, 10 ft. obstacle	1,490 ft.	Battery	14 x 17 amp.
Standard radio cable fuel capacity	84 gal.	Leading gear vertical distance, nosepoint	608 ft. 10 in.
Maximum payload fuel with optional auxiliary wing tanks	115 gal.	Power plant	1,000-hp C100 A1A @ 2,700 rpm
Oil capacity	220 lb.	Propeller	2 Hartzel 75 in. diameter, full feathering
Maximum baggage capacity, net	270 lb.		Individually controlled variable pitch

operation with the P-80 aircraft. (PR 111410) and E110717 (111410).

International Aircraft Model 10, P-80. (PR 111410) and E110717 (111410).

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Schroeder Plant

This new plant, for Sept. 1 company, will be located in Schroeder Manufacturing Inc. to produce sub-volts systems from current 100,000 to 10,000 units. Building covers 10,000 sq. ft. and will house 200 employees, including in expanded engineering department. Schroeder Manufacturing which makes valves and other electronic for the aircraft industry, was recently bought by Frederick W. Schroeder of New York. Plant is located in the Rancos Sea Industrial area of Los Angeles.

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Navy Contracts

Following is a list of classified contracts of \$25,000 and over as released by Navy Contracting Office:

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RESEARCH. Rocketdyne Research, a section of the Engineering department, has several openings for scientists and engineers with advanced abilities. Fundamental studies are being made in thermodynamics, gas dynamics, combustion and engine systems and advanced techniques, propellant chemistry and many other fields.

For detailed information, please fill out and mail the coupon below. There is no obligation, and all replies are strictly confidential.

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A general listing follows. Further information on these and many more positions may be obtained by writing Robert McDonnell, 6100 Route 240-42.

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TEST ENGINEER

Proven and capable in testing complex aircraft subsystems and to perform the test functions. Must be capable in the design, the status of test techniques and conducting repair programs. Must have experience in aircraft test functions and subsystems.

PILOT ENGINEER

Proven and capable in being pilot/engineer of aircraft, conducting the test, control and maintenance systems. Must be capable of conducting the status of test techniques and conducting repair programs. Must have experience in aircraft test functions and subsystems.

OPERATIONAL PROGRAM ENGINEER

Proven and capable in being pilot/engineer of aircraft, conducting the test, control and maintenance systems. Must be capable of conducting the status of test techniques and conducting repair programs. Must have experience in aircraft test functions and subsystems.

RESEARCH AND DEVELOPMENT ENGINEER

Proven and capable in being pilot/engineer of aircraft, conducting the test, control and maintenance systems. Must be capable of conducting the status of test techniques and conducting repair programs. Must have experience in aircraft test functions and subsystems.

PROJECT ENGINEER

Proven and capable in being pilot/engineer of aircraft, conducting the test, control and maintenance systems. Must be capable of conducting the status of test techniques and conducting repair programs. Must have experience in aircraft test functions and subsystems.

PROJECT ENGINEER - AIRCRAFT EQUIPMENT

Proven and capable in being pilot/engineer of aircraft, conducting the test, control and maintenance systems. Must be capable of conducting the status of test techniques and conducting repair programs. Must have experience in aircraft test functions and subsystems.

RELIABILITY ENGINEER

Proven and capable in being pilot/engineer of aircraft, conducting the test, control and maintenance systems. Must be capable of conducting the status of test techniques and conducting repair programs. Must have experience in aircraft test functions and subsystems.

OPERATIONS ENGINEER

Proven and capable in being pilot/engineer of aircraft, conducting the test, control and maintenance systems. Must be capable of conducting the status of test techniques and conducting repair programs. Must have experience in aircraft test functions and subsystems.

QUALITY ENGINEER

Proven and capable in being pilot/engineer of aircraft, conducting the test, control and maintenance systems. Must be capable of conducting the status of test techniques and conducting repair programs. Must have experience in aircraft test functions and subsystems.

PROJECT ENGINEER

Proven and capable in being pilot/engineer of aircraft, conducting the test, control and maintenance systems. Must be capable of conducting the status of test techniques and conducting repair programs. Must have experience in aircraft test functions and subsystems.

PROJECT ENGINEER

Proven and capable in being pilot/engineer of aircraft, conducting the test, control and maintenance systems. Must be capable of conducting the status of test techniques and conducting repair programs. Must have experience in aircraft test functions and subsystems.

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MAC presently has stimulating engineering positions available in a great variety of fields including:

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Structures Engineering
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Airloads and Flight Criteria
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Aerostability and Flutter
Thermodynamics

Wind Tunnel Test Engineering
Flight Test Engineering
Reliability Engineering
Telemetry Systems Engineering

Flight and Vibration
Ground Support Equip. Engineering
Liaison Engineering

Our tremendous growth rate—exceeding 50% in personnel in the past year, has created many positions of technical leadership in our Engineering Divisions. For more information about our company and community, write in confidence to:

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Technical Placement Supervisor
P. O. Box 516
St. Louis 3, Missouri

McDONNELL
AIRCRAFT CORPORATION

Robert McDonnell, 6100 Route 240-42
Technical Placement Dept. 474

Direct Answer from Area Corp., Research Field, Suite 474, L. 1, R. 1.

COMPUTER ENGINEERS

DIGITAL • ANALOG



AC The Electronics Division of General Motors Corporation has specific career opportunities for engineers experienced in analog or digital computer design, development, and application engineering.

Experience in the following areas is desirable:

ANALOG COMPUTERS

1. Electro-mechanical analog computer instrumentation
2. Electro-mechanical computer design and Mechanization
3. Airborne computer systems

DIGITAL COMPUTERS

1. Logic design of special purpose computers
2. Pulse circuit design
3. Airborne digital computers
4. Memory design using Magnetic cores
5. Analog to Digital and Digital to Analog Conversion

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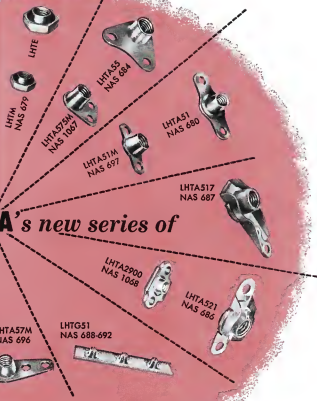
all-metal counterbored miniature self-locking nuts

Have you analyzed the structural design advantages and weight-saving possibilities offered by ESNA's AN approved versions of the new NAS low-height, lightweight, counterbored types of self-locking nuts?

For example, there is ESNA's LHTM-TE and LHTA51 series for structural applications which conform to NAS 679-695 drawings for low-height counterbored locknuts. These parts meet the tensile, vibration, twist- and push-out requirements of MIL-N-25027 (ASG), performing satisfactorily at temperatures up to 550° F; they also meet AN-N-5 and AN-N-10 tensile specifications and are dimensionally interchangeable with AN363, 364, 365, 366 parts. These nuts combine high strength with lightweight and reduced height; the counterbored base eliminates use of shims to keep threads out of bearing. Extra weight savings can be obtained by using them with new 160,000 psi short thread length NAS bolts.

Now, to meet the increasingly severe space limitations of new missile and avionic designs, ESNA announces the availability of a full line of NAS miniature, counterbored self-locking nuts conforming to NAS 696, 697, 698 drawings. All of these new Elastic Stop nuts use ESNA's AN approved offset crown locking device which exerts locking torque radially and elastically to assure vibration-proof tightness and extended re-usability.

For significant new developments resulting from space- and weight-saving fastener research look to ESNA, pioneer producer of the famous red collar Elastic Stop nuts.



**ELASTIC STOP NUT CORPORATION
OF AMERICA**

MAIL COUPON FOR DESIGN INFORMATION

Dept. N42-625, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastener information:

- ☐ Spec sheets on new LHTA51 Series ☐ Here is a drawing of our product. What type of self-locking fastener would you suggest?
- ☐ Spec sheets on new LHTA51M Series

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